CIVIL ENGINEERING

FEBRUARY 1952

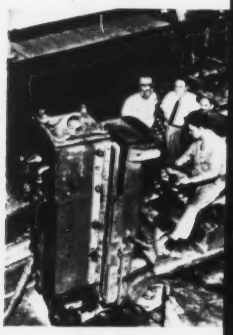
THE MAGAZINE OF ENGINEERED CONSTRUCTION

Korean bridge repaired by Army Engineers. See article by Colonel Fortson.

confronted with an oversize job?

. . . or a *small* one?

Driving Sectional Pipe Piles Inside Building with Hammer Mounted on Tournatot.



RAYMOND

has equipment to do both!

When you call in Raymond, you are turning your foundation work over to an organization which has specialized equipment, operated by expertly trained men, for pile jobs of any size. With 55 years of experience in foundation work ranging from a few test piles to more than 40,000 piles for one structure—Raymond has established a record for outstanding service.

THE SCOPE OF RAYMOND'S ACTIVITIES . . .

Soil Investigations, Pile and Caisson Foundations, Underpinning, Harbor and River Improvements and Cement-Mortar Lining of Pipelines by the Centriline and Tate Processes.

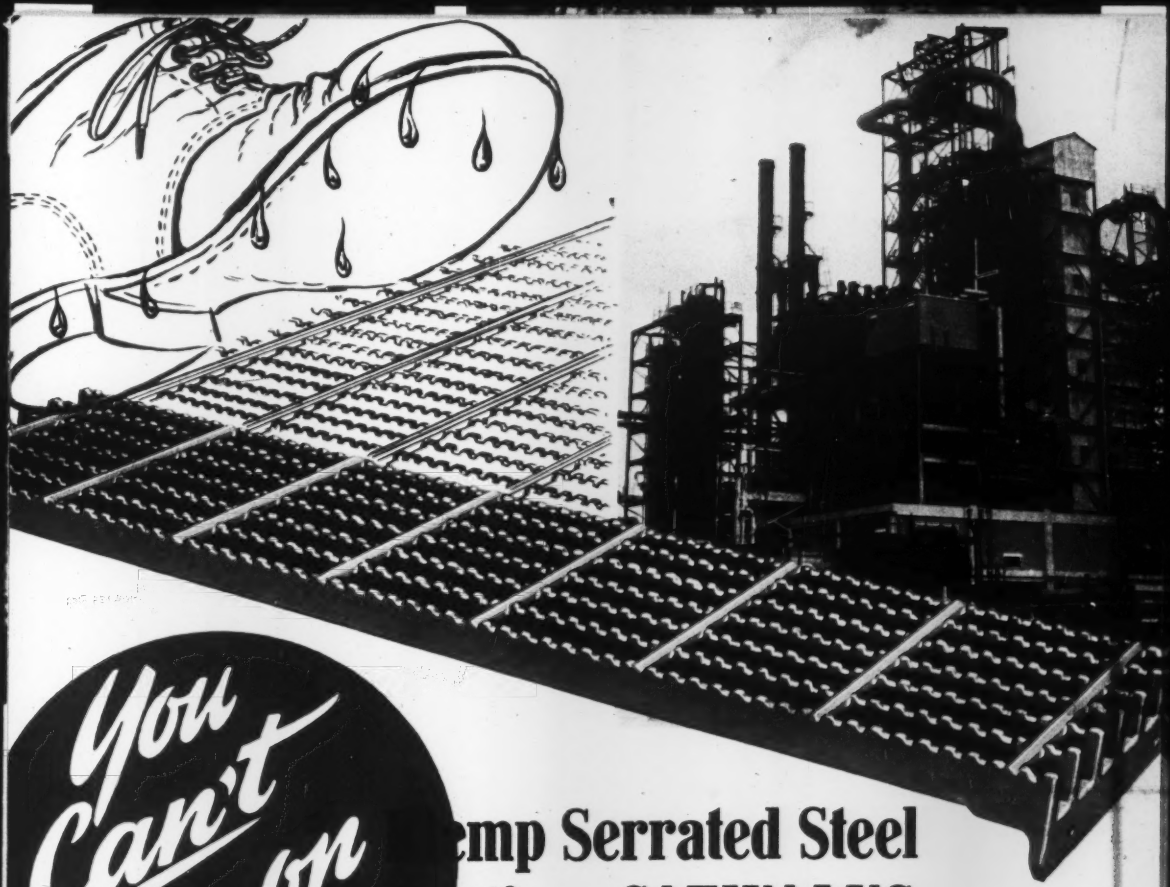
RAYMOND
CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

Branch Offices in Principal Cities of United States and Latin America

AROUND THE WORLD SINCE GEORGE

Looking up leads of Raymond Universal pilefdriver while driving precast concrete piles for Morganza (La.) Floodway Control Structure.



You Can't Slip on Klemp Serrated Steel Grating CATWALKS

ccidents caused by workers slipping on cat-cracker gratings, the Phillips asked Klemp to design a new, slip-proof grating. The result was: super-safe eel Grating. Even workmen whose shoes are slick with muck and oil walk safely saw-shaped teeth grip their shoes, and positively prevent slipping. That's why tandard Oil, Shell, and many other companies now use Klemp Serrated Steel Grating to avoid accidents and costly damage suits. This grating is available either in hydraulic-riveted or electro-forged styles.*

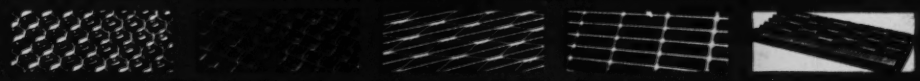
KLEMP SURE FOOTED AS A CAT SERRATED STEEL GRATING

Rugged Klemp Serrated Steel Grating is fireproof. Ice, snow, and dirt fall through it. Its open construction permits free access to water, chemicals, light and air; and hurricanes do not harm it as its rugged carbon steel gives with the wind. Get full details on how Klemp Serrated Steel Grating can boost safety and save you money. Write today for hot-off-the-press 1952 Klemp Grating Catalogue!

*Klemp's 45 years' experience as grating specialists guarantees perfect fabrication to your most exacting specifications.

WILLIAM F. KLEMP CO.

KLEMP SERRATED STEEL GRATING



in WIRE ROPE, too it takes the RIGHT KIND of muscle

The long flat muscles of the black panther give him the spring and suppleness he needs to survive in his particular environment. They're ideal for the job they're called upon to perform.

So, too, with wire rope! Specific jobs call for the right kind of muscle; the right construction and lay of the rope; the right grade of steel and size of wire...to best withstand the destructive forces encountered.

Wickwire Rope gives you the benefit of long experience and specialized know-how which assures you of exactly the right kind of rope your particular job demands.

For additional information write or phone our nearest sales office.

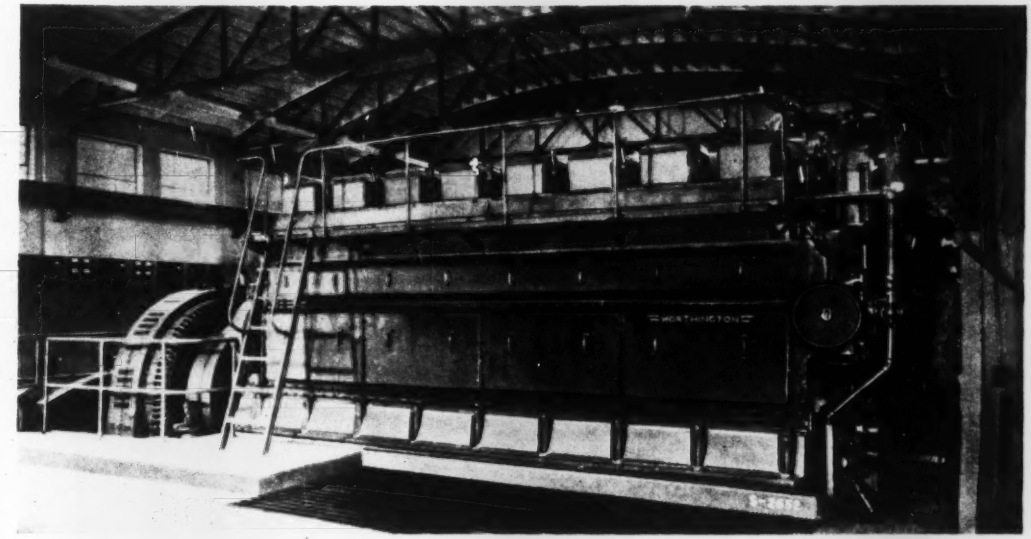
THE COLORADO FUEL & IRON CORPORATION–Abilene (Tex.) • Denver • Houston • Odessa (Tex.) • Phoenix • Salt Lake City • Tulsa
THE CALIFORNIA WIRE CLOTH CORPORATION–Los Angeles • Oakland • Portland • San Francisco • Seattle • Spokane
WICKWIRE SPENCER STEEL DIVISION–Boston • Buffalo • Chattanooga • Chicago • Detroit • Emlenton (Pa.) • New York • Philadelphia

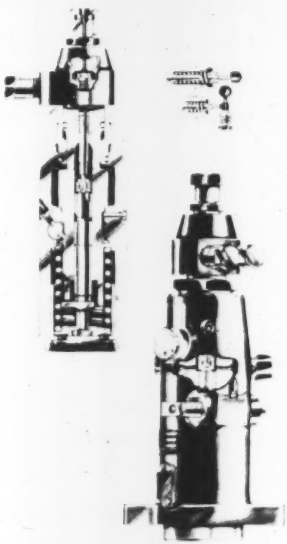
WICKWIRE ROPE
A CF&I PRODUCT

LOOK FOR THE YELLOW TRIANGLE ON THE REEL

WICKWIRE ROPE
CF&I
PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL & IRON CORPORATION

CIVIL ENGINEERING, The Magazine of Engineered Construction, February, 1952. Vol. 22, No. 2. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50c a copy, $5.00 a year in advance; $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75c and foreign postage $1.50 additional. Entered as second class matter September 25, 1940, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on July 5, 1918.





Worthington-designed dual plunger fuel pump.

This Diesel Is Ready

FOR A CHANGE IN DIET

Right now this Worthington Diesel—one of three 1760 hp units owned by the city of Tarboro, N. C.—is operating on oil.

But they anticipate natural gas in this area, and this Diesel is ready for it. With slight changes, it can easily be converted.

Worthington-designed dual plunger pumps now completely fuel this engine with oil—producing more perfect atomization, making possible the use of a *heavier* grade of oil. Also: firing pressures are reduced, exhaust temperatures, too, and combustion is improved.

When the conversion to gas is made, the dual plunger pumps will furnish pilot oil for ignition. Conversion is made quickly and at low cost.

For any engine application, call on Worthington—an engine for any fuel: oil (crude or regular), gas or "dual fuel". Worthington's complete line of engines assures you of the most economical operation no matter what fuel you use.

Only Worthington dual fuel engines offer such exclusives as dual plunger pumps, gas micro-metering valves for each cylinder, and automatic thermal air control—all built to give optimum performance for the fuel used.

Write for Bulletin S-500-B 31 C, Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.

WORTHINGTON

ENGINES

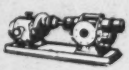
E.1.12

ECONOMICAL CONTINUOUS POWER

Diesel Engines, 150 to 2640 hp
Gas Engines, 190 to 2880 hp
Dual Fuel Engines, 345 to 2640 hp

WORTHINGTON-BUILT AUXILIARIES

Engine Starting Compressors



Oil Transfer Pumps

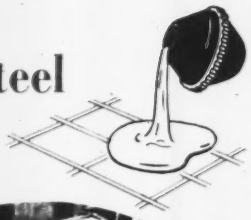
Cooling Water Circulating Pumps

Evaporative Type Engine Water Coolers

The ACI Code proves it . . .

You don't have to buy so much steel

when you use American Welded Wire Fabric



● Read the American Concrete Institute Code and it will show you how to save steel by specifying American Welded Wire Fabric.

Example:

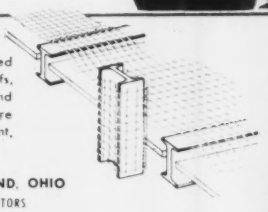
American Welded Wire Fabric is allowed a working stress of 28,000 psi for short span floor construction. That's 40% saving of steel over other types of reinforcing materials. Because the fabric is prefabricated, less labor is required – there is less steel to handle – it takes less time to place – there is less material to transport.

Example:

The specifications for reinforced concrete walls call for minimum ratios of steel area to wall area. If you use American Welded Wire Fabric, you can use 28% less steel area than with other reinforcing materials. You don't have to buy so much steel to get the strength you need.

These figures are impressive. They mean that you save critical steel when you use American Welded Wire Fabric. But just as important is the fact that you save critical labor. American Welded Wire Fabric is so easy to install that you just can't make a real comparison. Take slab construction: You simply unroll the fabric, lap the joints and you're done. No other reinforcement material can be installed so quickly.

Standard sizes of American Welded Wire Fabric are now readily available from jobbers' and dealers' stocks, supplemented by prompt mill shipments to identified projects. Present CMP Regulations assure adequate warehouse stocks of Fabric.



This sketch shows where American Welded Wire Fabric is used in modern concrete buildings. It reinforces walls, floors and roofs, can be draped over beams and girders and wrapped around pillars. Many uses of concrete in irregular structural shapes are made practical by American Welded Wire Fabric reinforcement.

AMERICAN STEEL & WIRE DIVISION, GENERAL OFFICES, CLEVELAND, OHIO

COLUMBIA GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS

TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Every type of concrete construction needs

U·S·S AMERICAN WELDED WIRE FABRIC *reinforcement*

UNITED STATES STEEL

IN 1952 For the 15th Consecutive Year...

The POWER GRADERS That Have Everything!

Controlled Traction
Precision Sideshift
High-Lift Blade
Extreme Blade Reach
Completely Reversible Blade
Full Hydraulic Control

+ the Best Bulldozer in the Business

Thanks to Exclusive All-Wheel Drive and All-Wheel Steer

AUSTIN-WESTERN COMPANY · *Subsidiary of Baldwin-Lima-Hamilton Corporation* · AURORA, ILLINOIS, U.S.A.

BALDWIN BLH LIMA-HAMILTON

Austin-Western

Laying one of the three courses of hot-mix Texaco Asphaltic Concrete, constructed on 35 miles of Indiana Route 46 near Greensburg by the Breslin Construction Company of Louisville, Ky.

A 35-mile resurfacing project on Indiana's Route 46

For resurfacing various sections of the Indiana State Highway System during 1951, two types of Texaco asphalt paving mixes were used. One of the principal differences between the two mixes lay in the asphalt product employed as binder. Both Texaco RC-5 Cutback Asphalt and a 60-70 penetration Texaco Asphalt Cement were used for the purpose on Indiana highways last year.

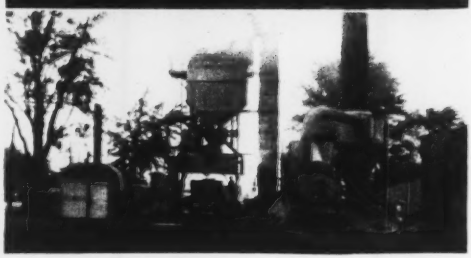
In the case of the 35-mile section of Route 46 illustrated here, 60-70 penetration asphalt served as binder in the new hot-mix Texaco Asphaltic Concrete pavement. The pavement was laid in three courses, each one-inch thick. The first two were binder courses and the third, the wearing surface.

In Indiana and throughout the rest of the country east of the Rockies, Texaco Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils perform an all-around service for the road builder. For heavy-duty paving, low-cost surfacing, undersealing concrete, joint-filling, surface-treatment and dust-laying, there is a Texaco asphalt product exactly suited to the purpose. Behind these products is almost 50 years of experience in refining asphalt from carefully selected crudes.

Faithfully yours

50 *for Fifty Years*

Two helpful booklets covering all types of asphalt construction can be obtained without cost or obligation by writing our nearest office.



Completed section of resilient, heavy-duty Texaco Asphaltic Concrete pavement on Route 46.

Asphalt plant of the Breslin Construction Company, which turned out approximately 70,000 tons of asphalt mix for this project.

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

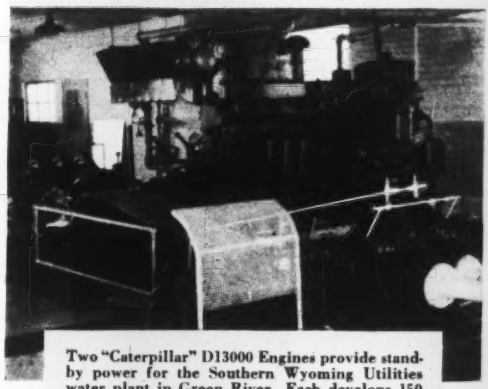
Boston 16 Chicago 4 Denver 1 Houston 1 Jacksonville 2 Philadelphia 2 Richmond 19

TEXACO

REG. U. S. PAT. OFF.

TEXACO ASPHALT

They saved the day when the regular power failed



Two "Caterpillar" D13000 Engines provide standby power for the Southern Wyoming Utilities water plant in Green River. Each develops 150 horsepower for maximum duty.

In addition to the two "Cat" Diesel Engines housed in this plant as standby power for Green River, Southern Wyoming Utilities employs other D13000s for similar work in other communities.

One of the most serious crises that can confront a community is the breakdown of its water supply. Lack of water for drinking, sanitation and fire fighting menaces health and property, so an effective preventive measure against this grim possibility is an invaluable investment.

Consider, for instance, how such a precaution saved the day in Green River, Wyoming. When the regular power failed at the pumping station, there wasn't a moment's break in the water supply. Southern Wyoming Utilities had installed two "Caterpillar" Diesel Engines as standby power, and they instantly took over the pumping job. Both are D13000s, each developing 150 horsepower for maximum duty. One drives a centrifugal pump delivering 1,000 g.p.m. against a 300-foot head. The other drives a vertical turbine pump with a capacity of 1,500 g.p.m. against a 170-foot head. Southern Wyoming Utilities, with headquarters at Rock Springs, uses other "Cat" D13000 Engines on similar work.

Instant response is an important requisite in standby power. Because of their record in emergencies and their economical performance in the long run, "Cat" Diesel Engines and Electric Sets are found in many fields – in utilities, in municipal, county, state and federal departments and in thousands of contracting and industrial concerns. Users have discovered that "Caterpillar" Dealer service is competent and always available. They have also discovered that proper maintenance by their own personnel pays off.

A few minutes' daily care keeps a sturdy "Caterpillar" unit in excellent condition and adds many extra hours to its working life.

CATERPILLAR, PEORIA, ILLINOIS

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS
MOTOR GRADERS • EARTHMOVING EQUIPMENT

Puts a River in its Place

THE BIG RED CHAMP BUILDS UP THE WALL. The International TD-24 is the work champ of the levee and of the world. It's the most powerful crawler tractor made, and the fastest. Also a champ for "handle-ability," with fingertip control for pivot turns, feathered turns, and turns with power on both tracks. All this means it moves more paydirt per day.

Four International crawlers help build wall to save town and mines from Ohio floods

Three times in five years the Ohio River rampaged through Rosiclare, Illinois. Each time it flooded the great fluorspar mines there, the biggest in the world, America's most important source of this vital fluxing agent used in making steel.

J. D. Barter Construction Co. was given the job of taming the river with a $360,000 flood wall. Four out of the five crawler tractors he put on the project are Internationals, and Sam Barter tells why:

"They really do a job, that's why! And they can take it as well as dish it out. We have one TD-18 with 3,000 hours that's never been touched. A TD-24 with 1,500 hours and not one minute's downtime."

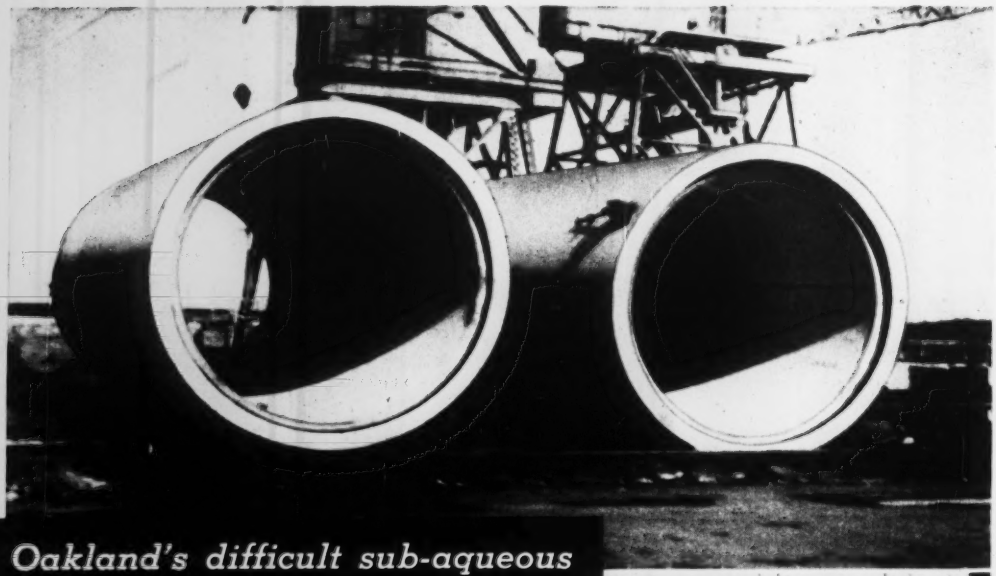
Check with your own friends who own International crawlers. And ask your nearest International Industrial Distributor for details on the whole International line. He's always at your call with expert service both in his shop and at your job site. Get the low-down. You'll go International from then on in!

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILL.

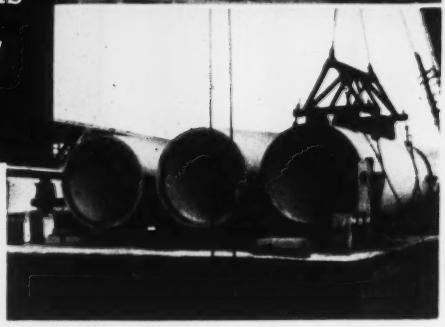
INTERNATIONAL

INTERNATIONAL HARVESTER

POWER THAT PAYS



Oakland's difficult sub-aqueous outfall sewer problem solved with ***CONCRETE PIPE***



Buried beneath 40 feet of water near the famous San Francisco-Oakland Bridge is another great engineering achievement. This is the sub-aqueous section of the outfall of Oakland's East Bay Municipal Utility District and consists of 5,970 feet of 96-in., i.d. reinforced concrete pipe. This giant sewer pipe was cast in 24-ft. lengths with walls 9 in. thick, each length weighing 39 tons.

In placing this great outfall the engineers faced many difficulties—bay bottom mud deposits ranging from 7 to 40 feet which had to be excavated, water temperatures of 50 to 55 degrees, heavy tides, pipe that had to be placed and aligned with divers and backfilled under water.

This is another example of how concrete pipe can be used to solve difficult or unusual sewer problems. In thousands of installations over scores of years, concrete pipe has demonstrated its rugged durability, great structural strength, maximum hydraulic capacity, minimum infiltration and leakage, and its tremendous resistance to wear from all types of abrasive matter.

Concrete pipe is moderate in first cost, requires little or no maintenance over the years and serves far longer. The result is real *low-annual-cost* sewer service.

Large photo above shows two 24-ft. sections of reinforced concrete sewer pipe on the bay shore dock before being loaded onto a barge for towing to the job site. Small photo above shows pipe being lifted from the barge at the job site. Photo below shows pipe section being lowered into place. Note how redwood chocks were used in giving the concrete pipe its final line check after it was placed.

AMERICAN CONCRETE PIPE ASSOCIATION
228 NORTH LA SALLE STREET, CHICAGO 1, ILLINOIS

Short cut . . . to better, lower-cost roads

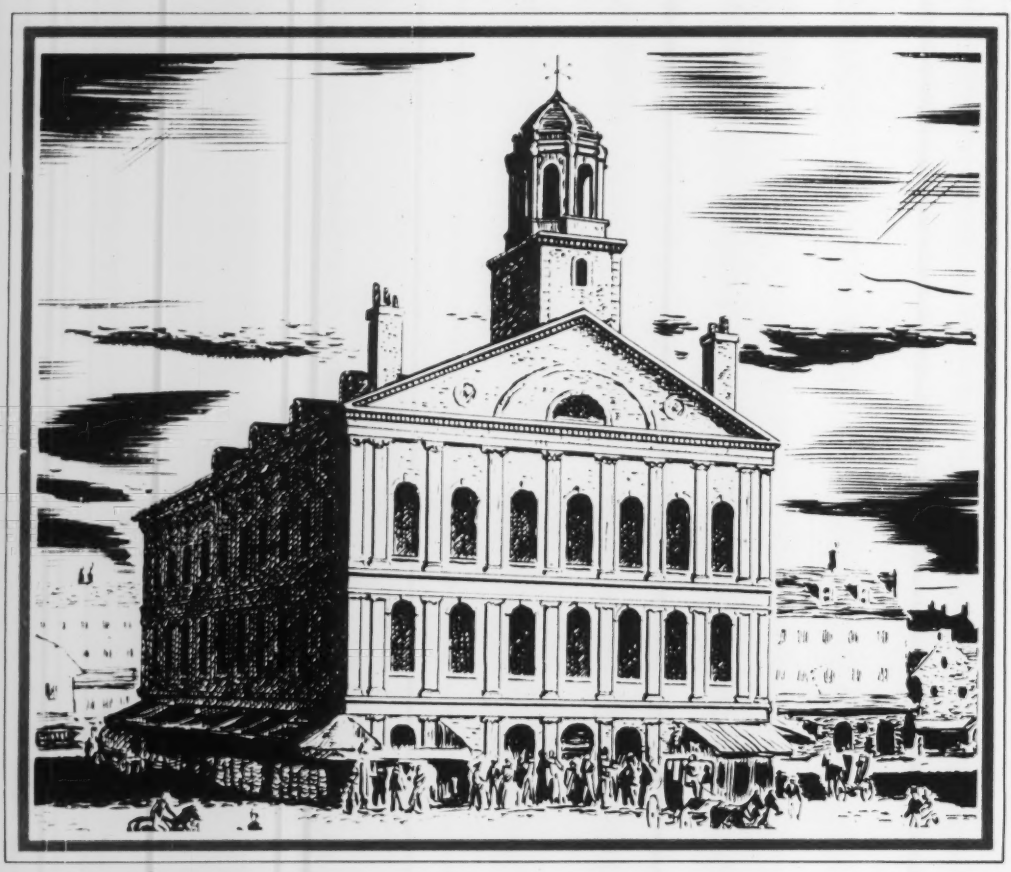
For a better road . . . a smooth, glare-free, safe road . . . asphalt construction or resurfacing offers real savings in time and money. It is quick-laying, low in cost. It is easy to maintain, long on service. And there's a saving through the use of local aggregate. For highways, secondary roads, and municipal streets, the short cut to a better road is through asphalt construction or resurfacing.

To make this short cut even shorter, take advantage of additional savings in shipping time and freight costs by specifying Standard Asphalt. With five asphalt-producing refineries located throughout the Midwest, Standard makes the haul to your site a short one.

A Standard Asphalt Representative can help you take advantage of this short haul . . . can help you select the type of asphalt construction best suited to your needs and local conditions. For his services, write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL
ASPHALT

STANDARD OIL COMPANY STANDARD *(Indiana)*



Boston's Faneuil Hall, popularly called "The Cradle of Liberty", as it looked 100 years ago.

Boston, Massachusetts, has cast iron water and gas mains in service that were installed more than a century ago. In those days, modern pavements were unknown; labor costs were low. Today, the expense of unnecessarily frequent repairs to underground mains, or untimely replacements, and consequent restoration of costly pavements, is a risk you cannot afford to gamble with. Cast iron pipe has an established record of long life and low maintenance. It effectively resists corrosion and possesses the four strength factors so necessary to meet the stresses imposed by modern traffic and crowded underground construction. These are shock, crushing, bursting and beam strengths. No pipe deficient in any of these strength factors should ever be laid in paved streets of cities, towns and villages. **United States Pipe and Foundry Co., General Offices, Burlington, N. J. Plants and Sales Offices Throughout the U. S. A.**

U.S. Cast Iron PIPE

NUMBER ONE OF A SERIES

Huge fabricating capacity and erecting short cuts count on big jobs

International Harvester Company, Broadview Parts Depot—4500 tons of steel fabricated and erected.

29 acres under one roof

Large jobs like this can be fabricated simultaneously in all three of our shops where identical equipment is available. That means speed which is pretty hard to duplicate. On location, the skill of erecting crews in getting the structure up means more speed and time saved.

Wherever structural steel is involved in large, small, or in-between size structures, send your plans and specifications to us to be estimated.

★ Clinton Bridge Corporation ★ Gage Structural Steel Corporation ★ Midland Structural Steel Corporation

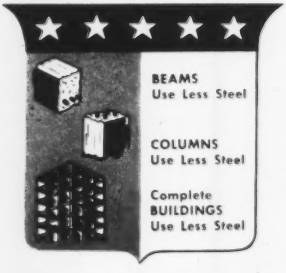
Fabricators and erectors of structural steel for highway and railroad bridges; industrial, office, school, and government buildings; Airport structures; Harbor facilities.

SAVE STEEL

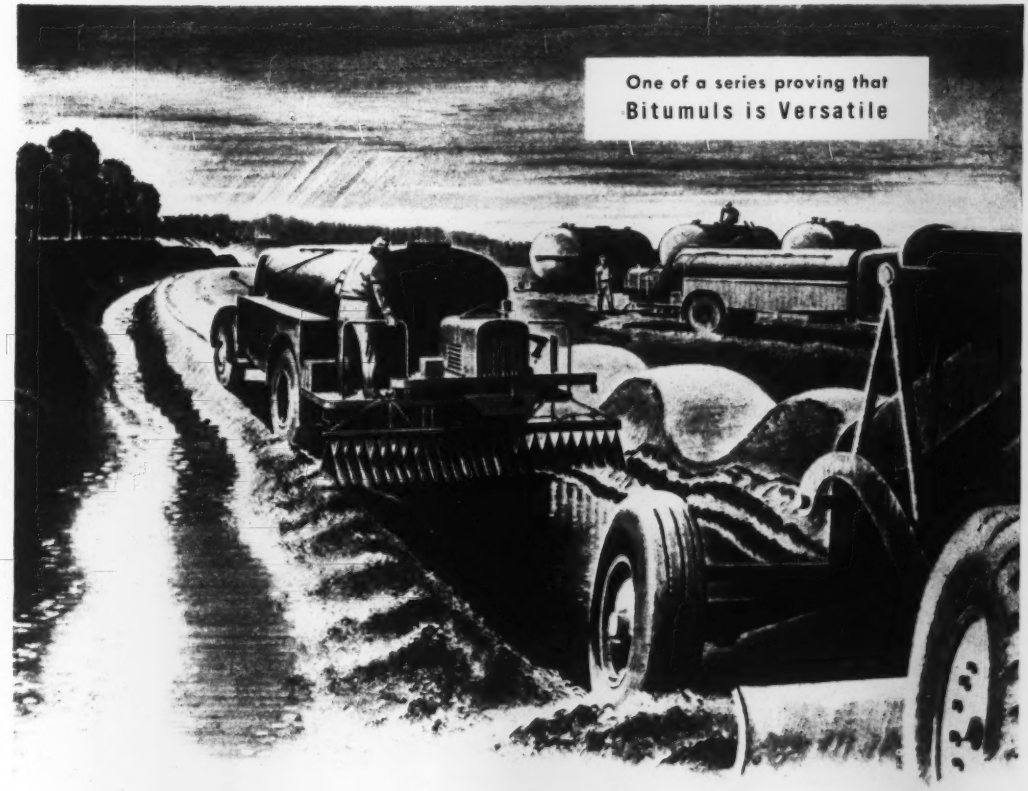
on your new structures

...build with REINFORCED CONCRETE

You can stretch your steel allotment and conserve steel for the defense effort by designing your buildings and other structures with reinforced concrete framing. Not only does reinforced concrete reduce the amount of steel required but it reduces framing costs, too, and saves valuable months in erection time. Furthermore, reinforced concrete is inherently firesafe, and provides a permanent, rugged structure that is highly resistant to wind, shock, and quakes. On your next structure, it will pay you to *design for reinforced concrete!*



CONCRETE REINFORCING STEEL INSTITUTE • 38 South Dearborn Street, Chicago 3, Illinois



How Bitumuls-sand "Stockpiling" makes road-crew time more productive

LOCAL SAND-PITS become sources of sound material for cold paving mixtures and wise labor utilization when Southern ingenuity puts winter-idled road crews to work with BITUMULS.®

No special equipment is needed. Sand used in this project is from abandoned pits or river banks.

Bitumuls HCM, even in "full formula" amount, makes an economical cold mix which is stockpiled during slack winter months for use during warmer summer weather. Workability is retained almost indefinitely without sacrifice of toughness, cohesion, or stability.

The Bitumuls-sand mix is suitable for surface, leveling courses or thick bases even where subgrade deflection may be anticipated.

Louisiana State Highway Engineers report that these rich sand mixes sustained far less damage than other types of paving during the unprecedented "freeze" of the 1950 winter season.

Mixing Grades of Bitumuls are ideal for treating virtually all available aggregates. Quick-Setting Grades of Bitumuls are favored the world over for armorcoat and macadam work. High Viscosity Bitumuls is recognized as standard for surface treating.

Nation-wide there are Bitumuls Engineers working out of strategically located plants. These men are specialists, qualified by training and varied experience to consult with you, to your advantage, about your paving needs . . . roads, parking areas or airports.

Bitumuls is ready for prompt delivery to your job site.

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Bitumuls & Asphalt
COMPANY

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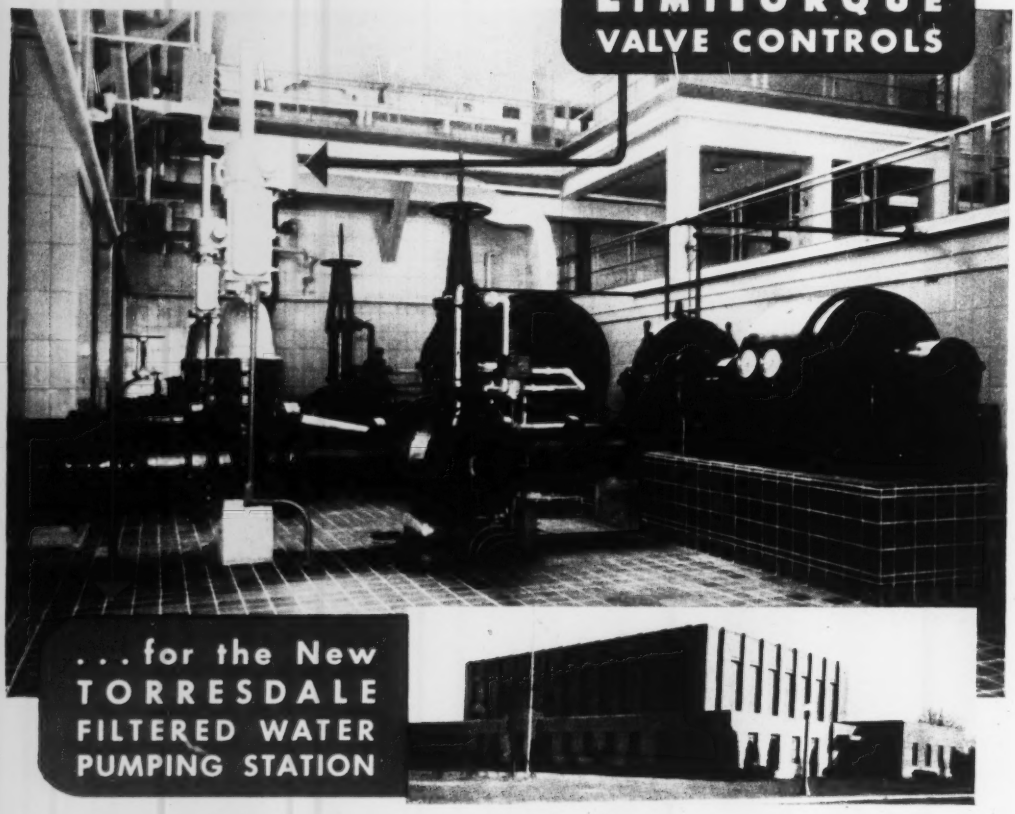
Providence 14, R. I. Perth Amboy, N. J. Baltimore 3, Md. Columbus 15, Ohio
St. Louis 17, Mo. Mobile, Ala. Baton Rouge 2, La. Tucson, Ariz. Inglewood, Calif.
Oakland 1, Calif. Portland 7, Ore. Seattle, Wash. Washington 6, D. C. San Juan 23, P. R.

Manufacturers of Asphalt and Asphaltic Products

SUPPLIERS OF ASPHALT FOR THE TURNPIKE

PHILADELPHIA PICKS PHILADELPHIA LIMITORQUE VALVE CONTROLS



. . . for the New TORRESDALE FILTERED WATER PUMPING STATION

Here, as at so many other modern water works stations throughout the country, LimiTorque Controls were selected for valve operation.

LimiTorque Remote Control permits one man to open and close large or inaccessible valves by merely pushing a button. All the while he can see the status of each valve on a panelboard. This saves considerable time and manpower and assures a better coordination of plant operation.

Damage to seats, stems, discs, etc., is prevented because LimiTorque shuts off the power if an obstruction occurs.

LimiTorque fits all types of valves and may be actuated by any available power source such as electricity, gas, water, air, etc.

Your valve manufacturer can supply them.

Valves shown with LimiTorque Controls were made by A. P. Smith Co.

Write for a copy of LimiTorque Catalog L-50 which gives full details of all types of LimiTorque Controls. Please write on your Business Letterhead.

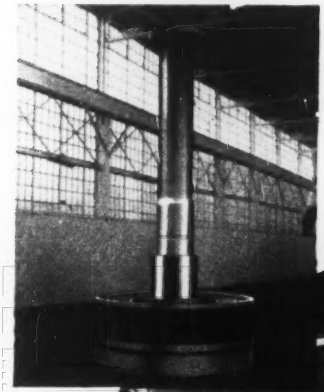
Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

IN CANADA, WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls



The *"Anderson Ranch"* POWER PROJECT
United States Bureau of Reclamation

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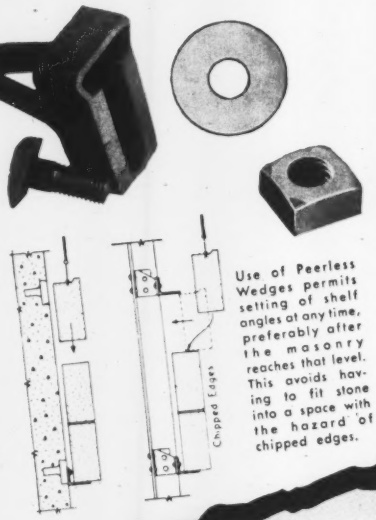

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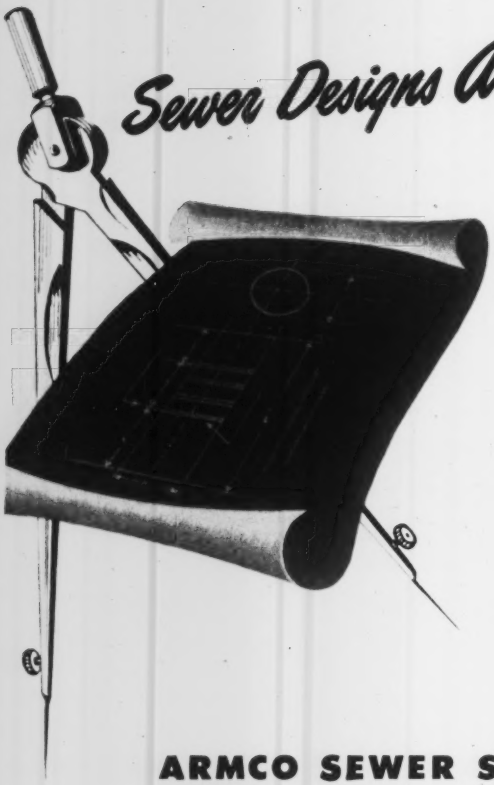

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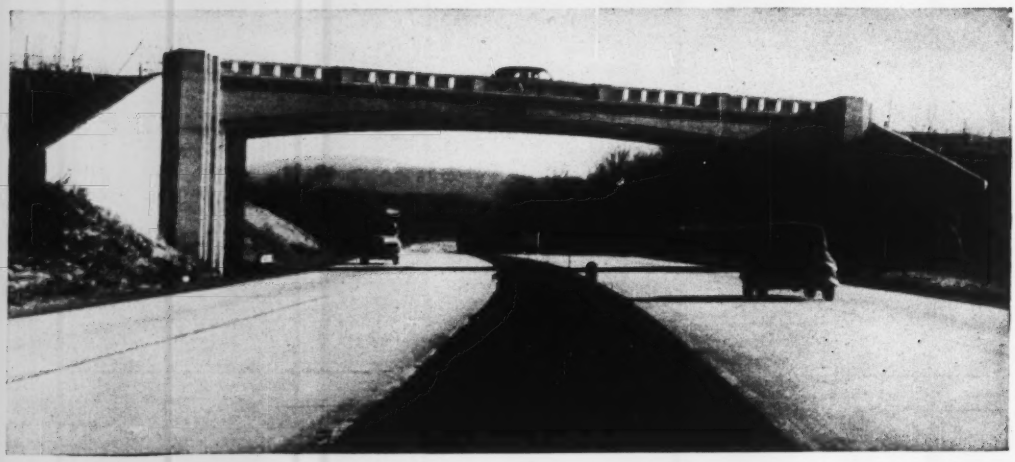

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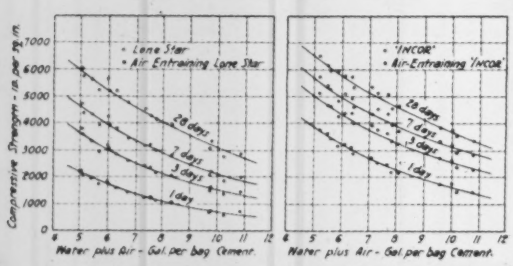

Fig. 2: (WATER + AIR) / CEMENT RATIO — STRENGTH RELATION
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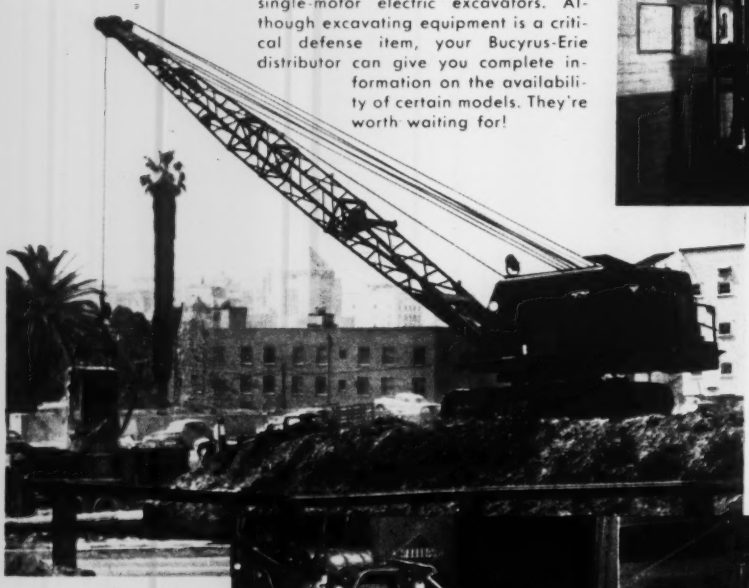

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MOST PREFERRED
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Aluminum alloy roof structure is internally stiffened to span 114-ft 6¾-in. steel storage tank near Beaumont, Tex. Roof plates, top angle, rafters, and girders are made of 61S-T6 aluminum alloy.

Aluminum alloys for corrosion-resistant storage tanks

E. C. HARTMANN, M. ASCE, Chief, Engineering Design Division, Aluminum Research Laboratories, Aluminum Company of America, New Kensington, Pa.

FRED L. PLUMMER, M. ASCE, Director of Engineering, Hammond Iron Works Warren, Pa.

Aluminum alloys are highly resistant to corrosion when exposed to many liquids which adversely affect steel and other metals. In addition, many liquids that would be adversely affected by contact with some metals are unaffected by storage in aluminum alloys. Among the liquids that fall in these two categories are the following: nitric acid in concentrations of 82 percent by weight or greater, organic acids such as acetic acid, alcohols, aldehydes, ammonium nitrate, esters, glycerin, highly purified water, hydrogen peroxide, hydrocyanic acid, ketones, nitroparaffines, organic acid anhydrides, petroleum products, vegetable oils, and many food and paint products. The corrosion-resistant characteristic of aluminum alloys, plus good strength, light weight, resistance to atmospheric weathering, nonsparking characteristics, and the ability to be worked by commonly

TABLE I. ALUMINUM ALLOYS MOST FREQUENTLY USED IN STORAGE TANKS

Product	Commercial Designation of Alloy	ASTM Designation	Temper Most Frequently Used	Nominal Composition Percent
Sheet or plate	3S	B178, alloy M1A	H14	1.2 manganese 98.8 aluminum
Sheet or plate	61S	B178, alloy GS11A	T6	0.25 copper 0.6 silicon 1.0 magnesium 0.25 chromium 97.9 aluminum
Structural shapes	61S	B211 and B221, alloy GS11A	T6	0.25 copper 0.6 silicon 1.0 magnesium 0.25 chromium 97.9 aluminum
Pipe	63S	B241, alloy GS10A	T6	0.4 silicon 0.7 magnesium 98.9 aluminum

TABLE II. TYPICAL MECHANICAL PROPERTIES OF ALUMINUM ALLOYS USED IN STORAGE TANKS

Alloy and Temper	Tensile Strength, psi	Yield Strength, psi (Offset = 0.2%)	Shear Strength, psi	Modulus of Elasticity, psi
3S-H14	21,500	19,000	14,000	10,000,000
61S-T6	45,000	40,000	30,000	10,000,000
63S-T6	35,000	30,000	22,000	10,000,000

TABLE III. MINIMUM THICKNESS FOR TOP-SHELL-RING SHEETS AND PLATES

61S-T6 aluminum alloy, for sheets and plate not more than 96 in. wide

Tank Dia., Ft	Thickness of Top Shell Sheets and Plates, Min., In.
10 to 50	3/16
50 through 120	1/4
140	0.29
160	0.35
180	0.41
200	0.48
220	0.53

used fabricating practices, have led to their adoption as the preferred metal for many types of storage vessels.

The three alloys described in Table I are of special interest. Alloy 3S is a non-heat-treatable alloy which is usually employed in a partially cold-worked temper. In this temper it is known commercially as 3S-H14. It is a relatively soft material and is ordinarily employed in the form of sheet and plate. Where maximum resistance to corrosion is desired, 3S sheet and plate are supplied with a metallurgically bonded cladding of another alloy which offers electrolytic protection to the 3S core. In this form the product is known as alclad sheet and plate.

When greater structural strength is needed in sheet and plate, the heat-treated alloy 61S is used. In the fully heat-treated temper, this material is commercially designated as 61S-T6. This alloy is also available in the form of standard structural shapes.

Many storage vessels have various arrangements of piping included in their design. In the case of aluminum alloy vessels, such piping is usually made of alloy 63S, which in its fully heat-treated condition is designated 63S-T6.

The properties of these materials have a rather wide range, and their typical tensile strengths at room temperatures range from 21,500 psi to 45,000 psi, as shown in Table II. All these alloys exhibit lower strengths at temperatures above about 200 deg F and all of them become stronger and tougher at low temperatures, according to the National Advisory Committee for Aeronautics (Technical Note 2082, "A Review of Information on the Mechanical Properties of Aluminum Alloys at Low Temperatures," by K. O. Bogardus, G. W. Stickley, and F. M. Howell, May 1950).

Use for Tank Roofs

The most vulnerable parts of many storage tanks, especially those used in the storage of sour crude petroleum, are the roof and top ring of the shell, which are exposed to the corrosive vapors given off by the contents of the tank. For this reason aluminum alloys are frequently used in the roofs and top rings. Among the roof types used are unstiffened dished and flanged heads, floating roofs, roofs with outside steel or aluminum rafters, and roofs with internal aluminum rafters. This paper deals primarily with the last mentioned type.

The general procedure for the design of internally stiffened aluminum alloy roofs is listed in the American Petroleum Institute Standard 12C, Appendix D, "Recommended Practice for Use of Aluminum Alloys in Construction of Tank Roofs and Top Shell Rings." It is suggested that the roof plates have a minimum nominal thickness of 5/32 in. for 61S-T6 alloy and 3/16 in. for alloy 3S-H14. The seams in the roof sheet may be either riveted or welded. The roof-supporting structure should be composed of structural shapes of 61S-T6 alloy, assembled by riveting or bolting. The rivet alloy used should be 53S-T61, which has an average shear strength of 23,000 psi in the cold-driven condition. The bolts used in such construction should be of aluminum alloy 24S-T4, anodically treated, having a typical shear strength of 41,000 psi. Hot-dipped galvanized steel bolts and nuts have also been used with aluminum alloy construction.

TABLE IV. RECOMMENDED MINIMUM SHELL PLATE THICKNESSES, IN INCHES

Aluminum alloy 3S-H14, 96-in.-wide, butt-welded courses

TANK HEIGHT, FT → 8	16	24	32	40	48	56	64
TANK DIA., FT							
10	1/4	1/4	1/4	1/4	0.29	0.34	0.39
15	1/4	1/4	1/4	0.36	0.43	0.50	0.58
20	1/4	1/4	0.28	0.38	0.48	0.58	0.67	0.77
25	1/4	1/4	0.35	0.48	0.60	0.72	0.84	0.96
30	1/4	0.28	0.42	0.57	0.72	0.86	1.01	1.16
35	1/4	0.32	0.49	0.67	0.84	1.01	1.18	1.35
40	1/4	0.36	0.56	0.76	0.96	1.15	1.35	
45	1/4	0.41	0.63	0.85	1.08	1.30		
50	1/4	0.46	0.70	0.95	1.20			
60	0.26	0.55	0.85	1.14	1.43			
70	0.30	0.64	0.99	1.33				
80	0.34	0.73	1.13					
90	0.39	0.83	1.27					
100	0.43	0.92						
120	0.51	1.10						
140	0.60	1.28						
160	0.69							
180	0.77							
200	0.86							
220	0.94							

Note: Lines indicate points beyond which plate over 1 1/4 in. thick is required.

For internally stiffened aluminum roofs, the top angle connecting the roof to the top ring is generally made of rolled or extruded 61S-T6 alloy. A 3 × 3 × 1/4-in. angle is recommended for tanks 35 ft in diameter and smaller, and a 3 × 3 × 5/16-in. angle for tanks 35 through 60 ft in diameter. For larger tanks, an angle of at least 3 × 3 × 3/8 in. is used.

When an aluminum alloy roof is used, the top cylindrical ring of the tank wall also may be constructed of aluminum alloy whether the remainder of the tank is of aluminum construction or not. Unless the remainder of the tank is welded 3S alloy construction, the top ring should be of 61S-T6 plate. The recommended minimum thicknesses of the top ring are given in Table III. A top ring of 61S-T6 is ordinarily attached to the steel shell with aluminum alloy rivets. Vertical seams may be riveted or welded.

When the entire storage tank is to be of aluminum construction, most fabricators prefer welding to riveting. Under these circumstances the wall plates and bottom of the tank are of 3S alloy. Table IV gives the recommended plate thicknesses assuming 96-in. butt-welded courses. A tank 50 ft in diameter and 24 ft high, for example, would use material at least 0.70 in. thick for the bottom course, 0.46 in. thick for the middle course, and 1/4 in. thick for the top course. The bottom of the tank would be constructed of plates having a minimum nominal thickness of 1/4 in., regardless of the size of the tank, and these plates would be either lap welded or butt welded following the general rules of Section 3.2 of American Petroleum Institute Standard 12C.

For butt welds in 3S alloy construction, the maximum allowable stress across the weld before applying the factor for joint efficiency is 5,000 psi. A joint efficiency factor of 0.85 is ordinarily used. For end and side fillet welds, an allowable stress of 2,400 psi on the cross section of the throat of the weld is used.

Riveted 61S-T6 plates and shapes are designed on the basis of an allowable net section tensile stress of 16,000 psi. The gross section allowable compressive stress is selected in accordance with the following column formulas:

For slenderness ratios less than 100, the allowable stress is 17,000 − 100 L/r, but should not be greater than 15,000 psi.

For slenderness ratios that are greater than 100, the allowable stress is $70{,}000{,}000/(L/r)^2$.

An allowable shear stress of 8,000 psi is used with 53S-T61 rivets and an allowable shear stress of 9,600 psi with 24S-T4 bolts. The allowable bearing stress for riveted construction is 27,000 psi, assuming that the edge distance in the direction of stressing is at least twice the rivet diameter. The allowable bearing stress for bolts is 18,000 psi.

Aluminum alloys can be worked by all the ordinary shop fabricating processes except flame cutting. They can be cut by a torch, but because they melt rather than burn, it is usually necessary to make the cut some distance away from the desired finished edge and to complete the cut by some other method.

A number of welding methods are used with aluminum alloy materials. Gas welding has been the most popular in the past for field-erected storage vessels. Newer methods such as the inert-gas metal-arc method are becoming increasingly popular, however, and will probably supplant gas welding in the construction of storage vessels. These newer methods eliminate the use of welding flux and permit welding in any position.

Aluminum is anodic to many other materials and may suffer electrolytic attack if it is in contact with a heavy metal such as copper, brass, or steel in the presence of an electrolyte. Solutions containing salts of such heavy metals have a similar effect if permitted to contact aluminum. In spite of this fact, however, steel and aluminum are often used together successfully in the same construction when suitable precautions are taken at all places of contact. The recommended procedure is to be sure that the faying surfaces in composite joints are carefully painted with zinc chromate paint and allowed to dry before being assembled. A calking compound is sometimes used in the faying surface of such composite joints to exclude all corrosive liquids and moisture, thus assisting in the elimination of electrolytic action.

(The above report on design practice for aluminum alloys was sponsored by the Structural Division's Committee on Design in Lightweight Structural Alloys, and presented at the Houston Convention before that Division, at its session presided over by Jewell M. Garrelts.)

Thaw-blast method prepares permafrost foundation for Alaska power plant

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A. NELSON SILLS, J. M. ASCE, Structural and Soils Engineer, Respectively

Alaska District, Corps of Engineers, Anchorage, Alaska

SITE PREPARATION for West Power Plant at Ladd Field, Alaska, cost close to $100,000. Direct payment to prime contractor for thawing and compacting ground amounted to $49,479.42.

BUILDERS of a 22,000-kw (future total) steam power plant at Ladd Air Force Base, Alaska, like other arctic and subarctic constructors, found themselves faced with foundation conditions that were difficult to predict. There are many theories about foundations on islands of permafrost, and many people have studied this phenomenon. This particular project, however, proved no exception to the engineering axiom that each problem has its own distinct solution.

After considerable study by the Corps of Engineers, Fay, Spofford & Thorndike and Dr. Karl Terzaghi, a program of thawing and blasting was worked out to consolidate the power plant site to conform with foundation bearing specifications. Similar thaw-blast procedures were employed in the tests which preceded the actual site preparation. The method proved satisfactory but expensive. Because of the large volume of construction planned in Alaska and the acute shortage of trained personnel, this plant required a longer construction period than ordinarily would be needed. The plant was completed in June 1951, and was cut into existing electrical and steam systems after an extensive testing procedure. No settlement has been noted, and no significant effect on the thermal regime is apparent.

Final location of the plant in July 1947 allowed field crews to start exploration of the site. Known general characteristics of the area dictated the need for more than surface investigations. Although the upper soil consisted generally of fairly stable sandy silts and sands, non frost susceptible below a small surface deposit, permafrost had previously been encountered, mostly in discontinuous masses and usually with their upper boundaries at least 10 ft below the surface. In the same area, at a nearby satellite airfield of similar geological structure, the question of the natural density of such soils, including the more coarsely grained deposits, had been raised. These questions defined the initial work to be done.

In the first phase of the field exploration, an effort was made to define the boundaries of the permafrost mass by probing with a section of 70-lb railroad rail. Resistance to penetration was found to vary not only with depth but with the density of the material. A general knowledge of the soil structure of the area made it possible to judge whether a marked increase in the resistance to penetration was due to natural, unfrozen, high-density material or to ice in the soil. Since the exact size and shape of the building was not yet known and the winter season was approaching, it was impracticable to complete this phase of the investigation until the following spring. Although the field investigations were conducted concurrently with the design of the building, little inconvenience was experienced as the results of the soil studies had little influence on the basic design of the foundation.

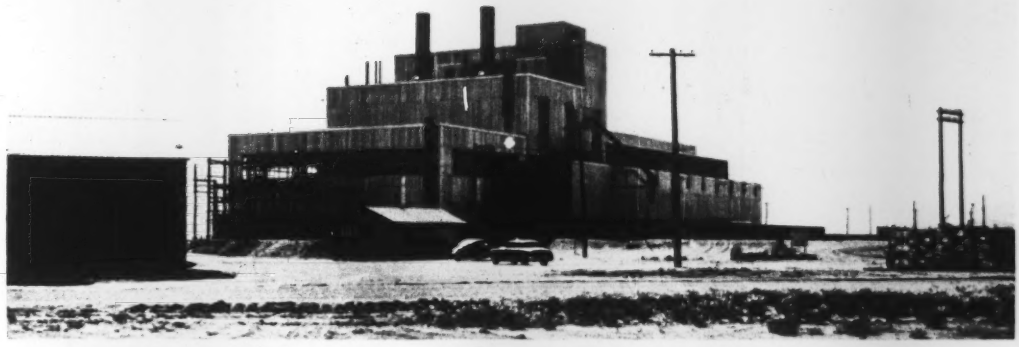
A building of the size and complexity of this power plant called for the use of conventional spread footings and elimination of the permafrost in the ground. A complete investigation was necessary to determine the cost involved in eliminating the permafrost and assuring a substructure having a safe bearing capacity within the limits of settlement allowed. After the general physical nature of the permafrost had been defined, a more detailed investigation of the mechanical and thermal properties of the ground was carried out. Dr. Karl Terzaghi, Hon. M. ASCE, one of the consultants, assisted in this work and was responsible for outlining the final specifications for the subgrade treatment.

Results of the probing previously described, combined with soil samples of frozen material taken in a 4-in. tube driven by churn-drill equipment, showed the area to be composed of river-deposited stratified sandy gravel, the porosity and grain size of which varied erratically. The porosity averaged 25 percent and the silt content 6 percent. This material was covered by about 12 ft of silts and silty sand of flood-plain origin.

The danger of compressible inclusions of silt or organic matter in the sand strata was a minor concern, as there was little evidence of such inclusions and only at such depths as would have small effect on the structural foundations. The density and related characteristics of frozen samples were obtained by working with the material in kerosene below the freezing point. Probing disclosed that, with the exception of unfrozen pockets, the area was underlain by permafrost from roughly 17 ft below the surface to 60 ft below in some cases.

The thermal characteristics of the proposed structure were such that the retention of permafrost was impracticable above a depth of 60 ft. The load-bearing characteristics of the frozen soil therefore had no bearing on the problem.

Densities and void ratios of the thawed material indicated that sig-



nificant consolidation could be anticipated under load before the soil reached a density compatible with its texture and moisture content. Efforts were focused, therefore, on procuring in-place data on settlement characteristics during and after thawing.

A thaw test was set up in the area to be covered by the boiler section of the plant. It consisted of a metal bearing plate 10 ft square set 23 ft below the natural ground surface and loaded with 600 psf. The pit was filled to a depth of 3 ft with water kept at a constant temperature of 140 deg for 30 days. Thawing was assisted by 16 steam jets placed in a 20-ft-dia circle around the test plate. Instrumentation included direct rod readings with transits and the use of thermocouples beneath and around the loaded plate.

Progressive settlement amounting to 0.8 in. was accumulated from 19 ft of thawing. A depth of thaw greated than 30 ft did not appear to materially increase this settlement. It was regretted that control of the heat introduced into the soil and the available instrumentation were inadequate to provide an explanation of other effects, some of which were rather unexpected. For instance, probing beneath the bearing plate disclosed an island of permafrost starting some 8 ft below the plate and completely surrounded by thawed ground. Furthermore the total depth of thaw was greater than anticipated on the basis of the assumed thermal characteristics of the soil, its moisture content and the temperature gradients during thawing. Not until the thaw load test had been concluded and the water was being pumped out of the pit, did the third unexpected effect appear. Light pumping equipment, previously adequate, was no longer capable of lowering the water. After 48 hours of pumping with the largest equipment available with no greater success, it was conceded that the thawed area had reached the water table, which in turn was deriving head from a water-filled gravel pit nearby and connected with the thawed area beneath or between lenses of permafrost.

Shock and Vibrations Used to Test Settlement

While it was now established that significant settlement would take place as a result of thawing, evidence existed, through correlation of this settlement with results of laboratory studies, that still more consolidation was to be expected. Because of the inherent difficulties of procuring undisturbed samples of consolidated, thawed, and saturated material, the method of shock and vibrations was decided on to gain information on possible further consolidation under load.

Blasting tests were set up, consisting of individual 8-lb charges of 20-percent dynamite inserted in the ground through a pipe which was later withdrawn. The charge was then covered with 19 ft of thawed soil. Four charges were equally spaced on a 20-ft radius from the center of the 10 × 10-ft test bearing plate previously mentioned and were fired individually at 5-min intervals. When the first charge was fired, the bearing plate was loaded to 50 tons by a hydraulic jack. Settlement of the plate and the load supports took place, but the jack pressure remained unaltered. The second shot caused further settlement and also reduced the jack pressure to 41 tons, which indicated that the bearing plates had settled slightly more than the support of the loaded platform. The jack pressure was reestablished at 50 tons, and it again dropped after the third shot, this time to 35 tons. The fourth shot had no effect on the jack pressure.

Levels in the area after the blasting showed that the blast-induced settlement under the bearing plate was 3.75 in. maximum. A fault scarp was sharply defined in the snow-covered slope of the thawed pit, indicating that the entire area located above the zone of thawing had settled at least 3 in. on the radius of 30 ft.

From the results of these tests, the final specifications were evolved to provide soil support for the structure that would bear 5,000 psf, with the differential settlement held to 0.5 in., a condition expected to prevail for the natural life of the structure. In brief, the plan to prepare the site for construction required thawing to 30 ft below grade and consolidation by blasting.

A calculated risk was taken regarding the thawing, by heat from the structure, of the permafrost remaining below this 30-ft depth. It is known that the load influence at the 30-ft depth will be small and the settlement from thawing alone negligible. The element of risk involves earthquake action on the thawed but nominally unconsolidated material, and the possible existence of compressible inclusions in the river-deposited, coarse-grained material in the zone which is expected to thaw in the course of time.

TEST PIT dug at site of power plant at Latitude 65 North clearly shows strata of permafrost and stratification of soil.

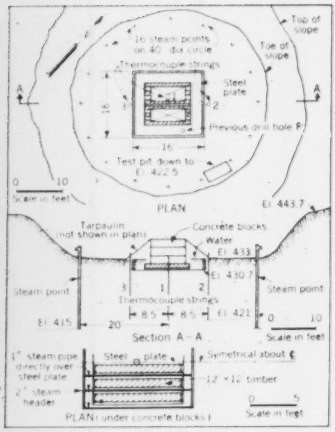


FIG. 1. PLAN AND SECTION of thaw-load test show layout of loaded platform and location of steam points. Water in test pit was kept at 140 deg F for 30 days. Settlement amounted to 0.8 in. for 19 ft of thaw.

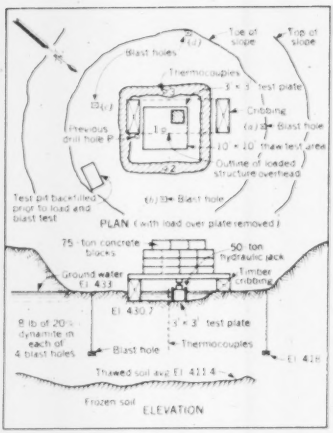


FIG. 2. BLAST TEST used individual 8-lb charges of 20-percent dynamite. Bearing plate was loaded to 50 tons. Maximum settlement under bearing plate amounted to 3.75 in.

Details of the site preparation work, of interest as field problems in their own right, are included here primarily to give support to the initial premise that permafrost, even in a coarse grained soil, often requires costly investigation and treatment.

Before the thawing and blasting of the foundation area as a whole, instrumentation was installed to record the results. Three temperature wells 36 ft deep were put down to indicate general thawing effects. To form each well, a 6-in. hole was drilled and a 1-in. thermocouple pipe installed. The 6-in. casing was then withdrawn and the hole backfilled with sand. To measure the change in elevation of the soil due to thawing and blasting, 51 reference pipes and 51 reference plates were placed in the area. Reference pipes were 2-in. standard pipe, 12 ft long, with a welded drive point at the lower end and a cap at the top. All pipes were driven 11 ft into the ground.

Adjacent to these pipes, on the surface of the ground, 9-in. square steel plates were placed. From these plates elevations were taken before thawing, after thawing, and after each of the three rounds of blasting. Following delineation of the permafrost areas to be thawed, steam points were jetted down 24 ft. The steam points consisted of lengths of $\frac{3}{4}$-in. pipe with two $\frac{1}{4}$-in. dia orifices at the lower end on each side of a fabricated chisel point. These points were placed on 7-ft centers over the entire area. To provide steam, two boilers with an estimated capacity of 220 hp each were set up on the job.

At several locations in the permafrost area, while points were being jetted down, water rose in adjacent pipes and spilled over their tops, which stood approximately 5 ft above the ground, indicating that the soil was not initially frozen to the full depth of the steam point, but was stratified with lenses of unfrozen material. During steam thawing, the boilers were operated at 60-lb pressure. Steam was delivered to the point manifold at from 12 to 35 psi. Nineteen days of continuous thawing completed the lowering of the permafrost approximately 13 ft over an area of 30,000 sq ft.

When it was ascertained that the entire area had been thawed, blasting patterns were set out. To place each blast charge, a 6-in.-dia pipe with a drive point was first driven into the unfrozen soil to a depth of 22 ft. This pipe was then withdrawn and a 5-in.-dia pipe, with a flat plate $\frac{3}{8}$ in. thick tack welded to the lower end, was dropped into the hole and driven to the 22-ft depth.

To place the dynamite bundles, made up of $\frac{1}{2}$-lb sticks tied and fused with primacord, it was necessary to fill the 5-in. pipe with water before the end plate was knocked off the bottom of the pipe and the bundle lowered into position. The 5-in. pipe was then withdrawn and the hole filled with soil. The blast pattern consisted of 48 holes on 25-ft centers. Each of the three successive patterns was offset 7 ft from the previous pattern. The charges were composed of 20 lb of 60-percent dynamite for the first round, and 15 lb for the second and third rounds.

Results of Site Blasting Evaluated

The most noticeable result of the first and second blasts was the formation of cavities directly over the points of blast. The cavities were formed below the surface and were evident where the surface soil had caved in. In some cases the surface opening was only about 1 ft in diameter and widened out to approximately 3 ft below ground. Some cavities were 4 ft deep. In part of the area, the effect of blasting was to create surface depressions 2 or 3 ft deep and 3 or 4 ft across. Results of the third blast were markedly different from those of the first and second. No cavities were formed at points of blast. Elevations taken after the third blast showed settlement of nearly all the reference points. No cavities were formed after the third blast, an indication that the desired

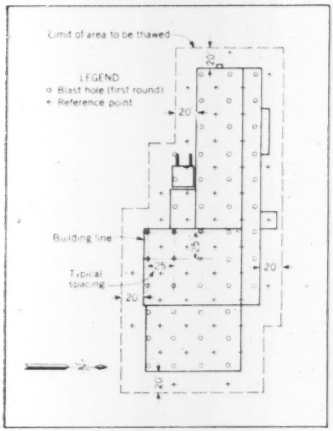
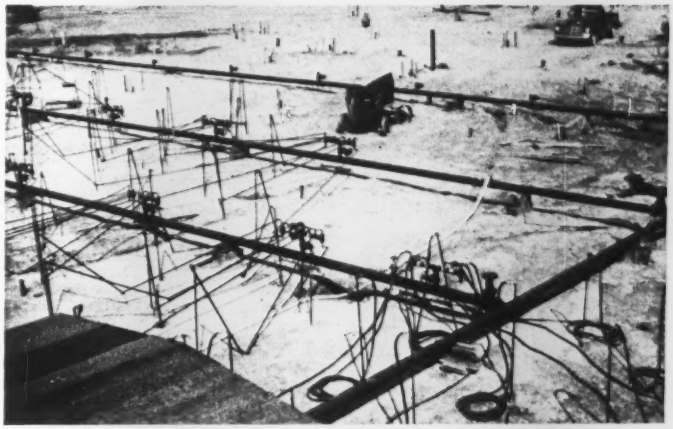


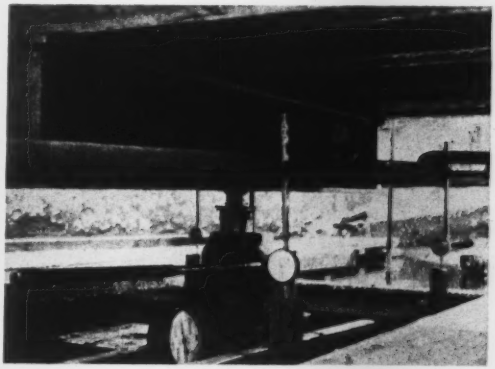
FIG. 3. PATTERN for first set of blast holes and reference points is shown. Each of three successive patterns was offset 7 ft from previous pattern. Reference pipes were 2-in. standard pipes 12 ft long.



STEAM THAWING of subsoil constituted first step in contract work of site preparation. Permafrost was lowered approximately 13 ft over 30,000 sq ft after 19 days of continuous thawing. Two boilers used had estimated capacity of 220 hp each and were operated at 60 psi.

consolidation had been accomplished. The blasting program was therefore considered complete.

Although the results of the thawing and blasting treatment were varied and in some cases unexplainable, the desired ends had been gained. The displacement of reference points in the area varied from a +0.621 ft to a −0.404 ft, the depressions or minus readings predominating over the greater permafrost masses, as was anticipated. The 3-ft-square test bearing plate loaded to 12,000 psf subsided 0.55 in. with a rebound of 0.15 in. on removal of the load, indicating the bearing to be within the specified value of 5,000 psf. The total cost to the government of this site investigation and subsequent treatment was close to $100,000; the direct payment to the prime contractor for thawing and compacting was $49,479.42.



LOADING JACK for blast-load test was set to 50 tons before each blast. Fourth blast had no effect on jack pressure, indicating that shock consolidation of soil had been completed.

Continuing Records to Be Kept

Because of the nature of heat flow through frozen and unfrozen soils in this geographic region, it will be a number of years before a final appraisal can be made of the relative success of this foundation treatment. The instrumentation of the structure now completed allows, however, for running records to be kept of temperature in the subgrade, of the water table, and of check levels at several points. The normal earthquake pattern in the area will provide ample agitation to assist freshly defrosted material to consolidate. The project should prove to be of continued interest to the builder and engineer in Alaska.

It is not to be concluded that the thaw-blast procedure is applicable or mandatory for every foundation where permafrost is encountered. The character of the soil and the loads to be carried will determine what treatment is advisable. In the case of a large hospital in the same general area, designed since the power plant here described, thawing of the permafrost to a 30-ft depth has been prescribed. Consolidation by pile driving was seriously considered but was decided against when an extended investigation of the foundation area revealed that the material in its natural state was sufficiently consolidated to be satisfactory.

The Resident Engineer for the Alaska District at Fairbanks, who had immediate charge of these activities, was Judson H. White. The Alaska District Engineer for the Corps of Engineers is Col. L. E. Seeman, M. ASCE.

Concrete box-girder bridge replaces

HOMER M. HADLEY, M. ASCE, Consulting Engineer, Seattle, Wash.

In the fall of 1948, King County, Washington, voted to float a $3,000,000 bond issue to provide funds for the replacement of various old and obsolete bridges with which type of structure the county is richly endowed. The largest project undertaken under this program was the construction of a new bridge across the Snoqualmie River at Duvall, a small town about 20 air miles northeast of Seattle. Located a few hundred feet north of the old bridge, the new bridge is 1,182 ft long from back to back of bridge seats. Spans, from west to east, are: six at 80 ft; three across the river of 117, 160, and 117 ft; and three at 80 ft (Fig. 1). These spans are continuous in sets of three.

Also included in the over-all length are the abutment structures, 20 ft long at each end, and the transition piers between the approach and the river spans, which are 14 ft long from center to center of girder bearings—or 15 ft 6 in. long overall. The deck has a 24-ft roadway and two 2-ft 9-in. curbs, making the total width 29 ft 6 in. Steel handrails are set so as to provide a narrow sidewalk on each side. The design loading is H15-S12.

The bridge is a reinforced concrete box-girder structure. The river spans consist of a single two-celled, three-web girder, 20 ft wide and 7 ft deep (Fig. 2). The 80-ft approach spans are carried by two separate girders, each 5 ft 6 in. wide and 4 ft deep (Fig. 3). Interior transverse diaphragms 6 in. thick and spaced 20 to 23 ft on centers are used in all girders. The outer faces of the approach girders are 20 ft apart and therefore lie in the same plane as the outer sides of the river-span girders. The girders of the approach spans are connected by 12-in. transverse diaphragms at mid span, and by heavy 2-ft diaphragms at the two-column bents, which are set in slightly from the plane of the girder sides. These bents are 19 ft wide and 2 ft thick, with columns 4 ft 6 in. wide. These columns have a common footing 25 ft long, 8 ft wide, and 3 ft thick, the top of which is set 2 to 3 ft below the ground surface to avoid interference with agriculture.

Simple, clean lines of new concrete box-girder bridge spanning Snoqualmie River, Duvall, Wash., contrast sharply with old, obsolete structure it replaces. Main river span is 160 ft long. Single box-girder 394 ft long is continuous over both river piers.

obsolete structure at Duvall, Wash.

Everyone familiar with bridges is aware of the unpleasing appearance which results in a deck girder structrue when girder depths change abruptly at a main pier or similar narrow support. Numerous examples of this unfortunate type of design are well distributed throughout the country.

To create a major architectural feature at such points is one way of avoiding the difficulty. In this bridge, the connection between the 7-ft-deep river spans and the 4-ft-deep approach spans is made in what are called the transition piers. These piers are 15 ft 6 in. in longitudinal dimension and 33 ft wide, crosswise of the bridge. In height they vary from 6 to 10 in. above the top of the steel handrail.

Being thus of greater width and height than the deck itself, and presenting broad unbroken surfaces, these seemingly massive elements so dominate the side view that the change in the vertical girder dimension is not noticeable. The massiveness of these piers is only apparent. Actually they are hollow shells with exterior walls, a central cross wall 8 in. thick, and interior pilasters 12 in. x 2 ft 4 in., centered on line with the outer girder webs.

Initially the nature of the foundation material was investigated by digging one test pit and driving four test piles at various points along the bridge site in order to check on earlier data. All piers east of the river are founded on either hard pan or hard-bedded clay. These materials dip downward at a very uniform rate toward the west. On the west main-river pier, the bottom of the seal was placed 8 ft below the low point in the river bed, on short steel piles. The west transition pier and Bent 5 are carried on composite concrete and wood piles which find end-bearing in the firm material. To the west of Bent 5, the hard material has dropped so far below the ground surface that composite piles 70 ft long failed to reach firm bearing, and the piles carry their 20-ton loads by friction only.

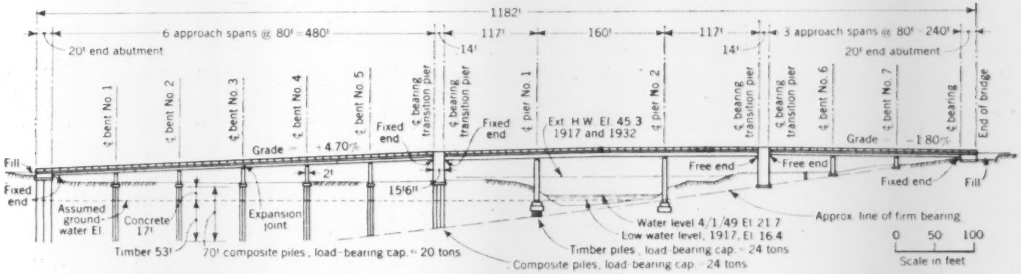


FIG. 1. Reinforced concrete girders in Duvall Bridge are continuous over three spans, as shown in elevation.

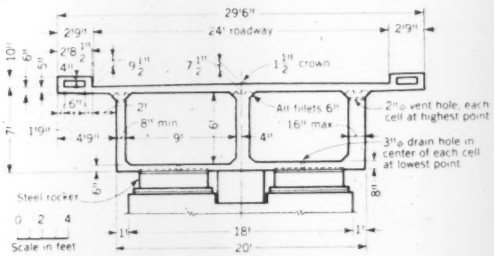


FIG. 2. River-span girder is two-celled box, keyed at piers to prevent transverse slippage.

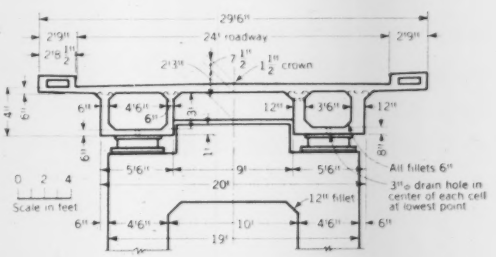
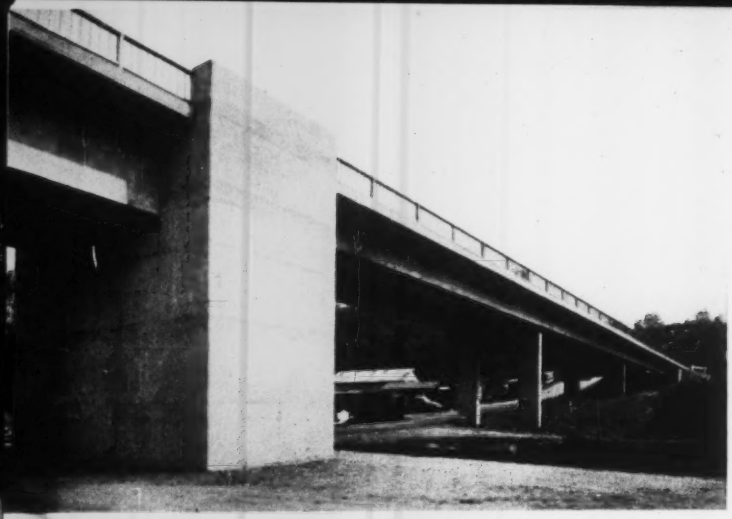


FIG. 3. Approach spans consist of two concrete box girders connected by 12-in. transverse diaphragm at mid span and by 24-in. diaphragms at two-column bents.



Heavy transition piers are designed to overcome usual unpleasing effect when girders of different depth meet at single slender pier. On this bridge box girders of approach spans are 4 ft deep while river-span girder is 7 ft deep. Transition piers are 15 ft 6 in. in longitudinal dimension and 33 ft in transverse dimension.

As previously stated, the girders are continuous in sets of three. The west abutment is the fixed point for the first set of girders; the west transition pier is the fixed point for the sets extending to the east and west of it; and the east abutment serves as the fixed point for the most easterly set of girders. These fixed ends are simply pinned connections which are free to rotate but not to displace. All other supports are on rockers and are free to move longitudinally.

Transverse displacement at the supports was prevented on the approach spans by extending a central section of the bent upward between the two girders for a height of 12 in. Asphaltic joint fillers $\frac{1}{2}$ in. wide on both sides provide the necessary clearance between girder sides and the interlocking key section. On the main river spans, where the box girder is 20 ft wide, the conditions were reversed by notching the top of the pier to a width of 4 ft 1 in. and a depth of 12 in., into which projects an integral key section from the girder above. Here again $\frac{1}{2}$ in. asphaltic joint fillers provide the separation between pier and girder concrete and permit free and uninterrupted movement.

All Substructure Sections Solid

Except for the transition piers and abutment structures at the ends, all substructure sections are solid. The box girders have a bottom-slab thickness of 6 in. The minimum web thickness of the approach girders is 6 in., and the maximum, 12 in. On the river girders the minimum is 8 in. and the maximum, 16 in. There appears to be no logical reason for increasing the minimum web thickness on the deeper girders except that such is the requirement on federal-aid projects, of which this is one.

What may be described as a delicate nuance of design was the further requirement that the abrupt increases of web thickness at a single point—for example, from 6 to 8 in. or from 9 to 10 in., as specified in the original design, where shear approached the maximum value allowable—be made gradual with a 1 in 4 taper or slope. The extreme refinement of this provision is noteworthy in view of the fact that $0.06\ f_c'$ is the maximum permissible shear on federal-aid projects—although the Joint Committee and the American Concrete Institute specifications permit $0.12\ f_c'$. On earlier federal-aid projects, abrupt changes in web thickness of this type were made without disaster and even without perceptible ill effect.

Deformed reinforcing bars $1\frac{1}{2}$ and 2 in. square are available in most of Washington and are extremely useful in long spans. They were employed in this bridge and were welded when extra length was required. Welds were staggered and of the shear type. An excellent and simpler weld that does not require turning over a long and heavy bar can be made by butt welding, with V-cuts from both sides of the abutting bars.

In appraising any structure the question, "What did it cost?" should be examined. Six bids were submitted on this project. A small amount of road work at both ends of the bridge was included in the bid. Major details of the three lowest bids are given in Table I.

Bids were opened on August 15, 1950, and the bridge was opened to traffic slightly less than one year later. Flood conditions in the river during the winter months had slowed progress.

D. L. Evans, M. ASCE, is King Country road engineer. The contractor, the State Construction Co. of Seattle, produced a very excellent structure. The bridge was designed by the writer.

TABLE I. Major Details of Three Lowest Bids

Items Bid	State Construction Co.	S. S. Mullen, Inc.	Anderson Bridge Construction Co.
Total bid	$352,942.34	$361,284.47	$363,805.55
Bridge only	349,245.84	357,438.47	359,594.55
Unit prices			
Structure excavation, 2,282 cu yd	4.00	3.50	5.00
Shoring and cribs, lump sum	18,000.00	11,000.00	18,000.00
Furnishing timber piling, 7,827 lin ft	0.40	0.54	0.50
Furnishing precast concrete piling, 3,680 lin ft	5.15	4.50	5.50
Driving composite piling, 152, each	46.00	48.00	50.00
Concrete Class A, in place, 2,819 cu yd	70.00	74.00	70.00
Concrete Class D, in place, 273 cu yd	40.00	28.00	40.00
Reinforcing steel, in place, 573,550 lb	0.09	0.096	0.095
Structural carbon steel, 30,074 lb	0.30	0.26	0.30
Structural handrail, in place, 2,302 lin ft	8.50	11.50	10.00

More accurate population estimates by means of logistic curves

JOHN E. McLEAN, University of Illinois, Urbana, Ill.

FOR MANY years engineers have been making forecasts of the future population of cities in order to design water and sewage works, transportation and other facilities with a reasonable useful life. However, many difficulties beset the path of the forecaster in this field, and many of the methods used in the past have resulted in a high percentage of error. The five so-called "standard" methods of arithmetical progression, geometrical progression, decreasing rate of increase, graphical extension, and graphical comparison are all subject to error and must be used with discretion.

As illustrations of the lack of reliability of these methods the following three cases are cited:

Babbitt[1] estimated the 1950 population of Canton, Ohio, as 143,000 by using the method of graphical comparison on the basis of the 1940 census report. In 1950 the census reported it as 116,300, an error of 22.9 percent in ten years.

In 1914 Metcalf and Eddy[2] estimated by arithmetical progression that the 1950 population of Milwaukee would be 725,000; or 1,100,000 by geometrical progression; or 830,000 by graphical comparison. The census reported the 1950 population of Milwaukee as 632,651, indicating errors of 14.6, 74 and 31.2 percent respectively, for the three methods.

An estimate of the 1940 population of New Bedford, Mass., also made by Metcalf and Eddy,[2] by the method of decreasing rate of increase, resulted in an 89-percent error.

These three examples (summarized in Table III) show how hazardous the estimation of future population is. The savings that can be realized in the total cost of a project by having a more adequate population estimate will vary with the project, but obviously they can be considerable.

A sixth method of estimating population, by means of a logistic curve, although not new, has been found to yield more accurate results than the methods previously mentioned. This method was the result of extensive work by Raymond Pearl prior to 1924, and was reported in his book, *Studies in Human Biology*.[3] His method is basically a mathematical expression of Verhulst's theory,[4] which was paraphrased by C. S. Velz and H. F. Eich in their article, "How Old Are Our Cities?" (CIVIL ENGINEERING, October 1940), as follows:

"If a population is expanding in a society of unlimited economic opportunity, the rate of increase is constant. If it is growing in an area of limited economic opportunity, the rate of increase must tend to get less and less as the population grows, so that the rate of increase is some function of the population itself, limited to a saturation value by the level of economic opportunity."

Messrs. Velz and Eich made the valuable contribution of developing the logistic curve. The writer suggests a new application of this curve for the determination of saturation values.

Pearl's equation is a logistic curve in the form,

$$y = \frac{k}{1 + me^{a_1 x}} \quad \ldots (1)$$

in which y is the population at any time x from an assumed origin. The constants are determined by selecting three points uniformly spaced along the x-axis, (O, y_0), (x_1, y_1), and $(2x_1, y_2)$, and substituting in the following equations.

$$k = \frac{2y_0y_1y_2 - y_1^2(y_0 + y_2)}{y_0y_2 - y_1^2} \quad \ldots (2)$$

$$m = \frac{k - y_0}{y_0} \quad \ldots (3)$$

$$a_1 = \frac{1}{x_1} \log e \frac{y_0(k - y_1)}{y_1(k - y_0)} \quad \ldots (4)$$

The following notation is used here:

y = population at any time, x
k = saturation population
m = a constant
a_1 = a constant
P = percentage of saturation

The quantity k, which is called the saturation population because it is the upper asymptote of Eq. 1, must be positive and must exceed the latest known population. Negative values are discarded as extraneous and those smaller than the latest population known are discarded as not representing the full period of growth.

A logistic curve will represent with a high degree of accuracy the population changes that have occurred in most cities in the United States. It assumes that the cities started with zero population and will eventually reach a saturation level, k, at which they will remain relatively constant. It also assumes that there will be no significant cultural changes, such as the addition of large suburban populations, major changes in the economy, or major natural catastrophies. Of course violation of this last assumption will invalidate the results secured by this method just as it would those by any other method.

A comparison of the results by this method with those by the five previously cited methods has been made for the city of Dixon, Ill. Its population, as reported by the U. S. Bureau of the Census, is recorded in Table I and in the 1860–1950 section of the curve in Fig. 1.

Estimates of Dixon's population at the next three census periods are shown in Table II. The results of the first five methods could be substantially reproduced by anyone using the data in Table I. The method of making an estimate by Pearl's logistic curve will now be described.

Any three points which are equally spaced along the x-axis, and are

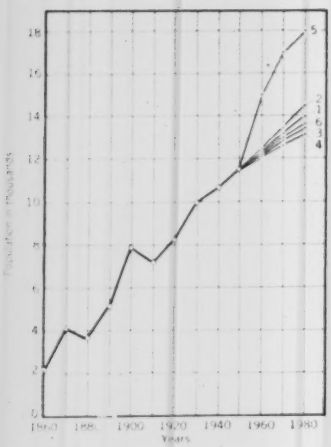


FIG. 1. Population of Dixon, Ill., is plotted for period 1860–1950 using U.S. Census data in Table I, and for period 1950–1980 using data derived from the five standard methods and Pearl's logistic curve, in Table II. Curve numbers are defined in Table II.

TABLE II. POPULATION ESTIMATES FOR CITY OF DIXON, ILL., BY SIX METHODS

Shown Graphically in Fig. 1

Method	1960	1970	1980
1. Arithmetical progression	12,344	13,156	13,968
2. Geometrical progression	12,440	13,430	14,490
3. Decreasing rate of increase	12,226	12,837	13,415
4. Graphical extension	12,100	12,600	13,100
5. Graphical comparison	15,000	17,000	18,000
6. Pearl's logistic curve	12,300	13,050	13,600

TABLE I. POPULATION OF DIXON, ILL.

According to U. S. Bureau of the Census (shown graphically in Fig. 1)

Year	Population	Year	Population
1860	2,218	1910	7,216
1870	4,055	1920	8,191
1880	3,658	1930	9,008
1890	5,161	1940	10,671
1900	7,917	1950	11,532

TABLE III. COMPARISON OF ERRORS BY STANDARD METHODS FOR THREE CITIES

As Compared with Those by Pearl's Method, in Percent

City	Original Population Estimate: Method	Error	Error by Pearl's Method
Canton, Ohio	Graphical comparison	22.9	4.9
Milwaukee	Arithmetical progression	14.6	9.0
	Geometrical progression	74.0	
	Graphical comparison	31.2	
New Bedford	Decreasing rate of increase	89.0	65.2

thought to represent the trend of population growth, are selected from a curve such as that in Fig. 1, from 1860 to 1950. For a first approximation, the origin of time has been placed at 1910 with a population of 7,216; with $x_1 = 20$ for 1930 with a population of 9,908; and $2x_1 = 40$ for 1950 with a population of 11,532. Substituting in Eq. 2 gives 12,900 for the saturation value, k. Values of $100\ y\ k$, called the percentage of saturation population, are plotted on the logistic grid first developed by Velz and Eich, as shown in Fig. 2.

As can be seen from the plot of the points for $k = 12{,}900$, the percentages of saturation population do not follow the lower part of the line. A second attempt is therefore made to secure a better fit. In this case the origin has been selected as 1880, with x_1 for 1910, and $2x_1$ for 1940. This gives a result of 14,100 for k. The points follow the line much better, but still further improvement is desirable.

In the last case, the origin has been placed at 1870 but a population of 3,330 has been selected from a study of Fig. 1 as being more representative of the general trend of the population at that time. Then x has been placed at 1910 with the population given in Table I, and $2x_1$ at 1950 using the Bureau of Census figure. This results in a value of 16,000 for k, which would seem to be the best value as shown by the way in which the points follow the line. The population in 1980, or at any other date, is found by reading the percentage of saturation from the grid and multiplying it by the saturation population, k. The extreme values of 11,000 and 26,400 for k are also plotted in Fig. 2 to round out the illustration.

Selection of the most adequate value of k might have been more accurately accomplished by a complete solution of the three constants, a calculation of the values of population at each of the census periods, and a correction by means of the method of least squares as outlined by Pearl.[3] However, this graphical method is felt to be easier, and sufficiently adequate to produce the necessary accuracy.

The logistic grid used in Fig. 2 was produced by plotting values of $-\log \frac{100 - P}{P}$, where P is the percentage of saturation along the y-axis, and values of time are evenly spaced along the x-axis. The scales can be made any convenient size, but larger scales can be more accurately plotted. This grid is based on a transformation and solution of the basic equation, Eq. 1, as follows:

$$y = \frac{k}{1 + me^{a_1 x}}$$

$$\frac{100y}{k} = \frac{100}{1 + me^{a_1 x}} = P$$

$$P + Pme^{a_1 x} = 100$$

$$me^{a_1 x} = \frac{100 - P}{P}$$

$$\log_e m \times a_1 x = \log_e \frac{100 - P}{P}$$

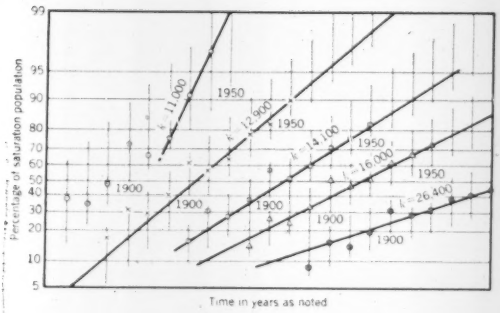


FIG. 2. Values for $100\ y/k$, called percentage of saturation population, are plotted on logistic grid developed by Velz and Eich to find which curve best fits data. In this case $k = 16{,}000$ seems to be the best fit.

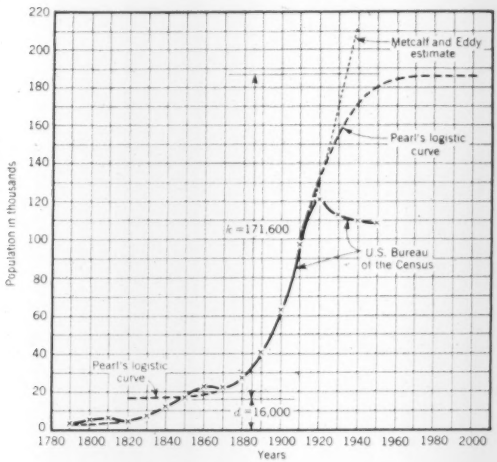


FIG. 3. Population-time curves for New Bedford, Mass., show how curve of actual population could not have been anticipated by any method, because of major change in life of community that took place during first World War.

$$x = -\left(\frac{1}{a_1 \log_{10} m}\right)\left(-\log_{10}\frac{100 - P}{P}\right)$$

Values of $-\log\dfrac{100 - P}{P}$ are plotted in either direction from 50 percent of saturation, the negative sign being attached to make the larger percentages positive. Variation in the scale of either x or y will only change the slope of the line and not the linear relationship on which this method depends. This is the reason why a straight line was drawn through the three points used in calculating k at each approximation.

Table III is a summary of the errors in the estimates mentioned earlier in this article as compared with the errors that resulted when Pearl's logistic curve was used with the original data. The large error in the results for New Bedford apparently came about because of some major change in the life of the community that took place during the first World War. It represents one of the situations which cannot be anticipated except by a knowledge of the particular circumstances that produced it. In Fig. 3, what has happened to the population of New Bedford is shown, together with a graphical presentation of the two estimates.

The city of New Bedford also illustrates a modification that must be made in the basic equation when a major cultural change has taken place in a community. A distinct change took place in the rate of growth around 1870 (see Fig. 3). If the curve from 1870 to 1910, the last population available at the time of the original estimate, is extended backward it would be asymptotic at about 16,000. The more general equation,

$$y - d = \frac{k}{1 + me^{a_1 x}} \quad \ldots (5)$$

where d is the lower asymptote of the curve, is therefore used. In this case only the population between 1870 and 1910 would be expected to lie along the line on the logistic grid. The lower asymptote, d, is subtracted from all populations before they are substituted in Eq. 2. The points plotted on the logistic grid are now $100\ (y - d)/k$, and d must be added to all populations subsequently determined from it. The most common form used is Eq. 1, because most of the cities in the United States started their present period of growth at zero population, as is assumed in this equation.

A more dramatic demonstration of the possibilities of Pearl's method is given by his own prediction of the population of the United States at various census periods,[3] based on the populations reported by the Bureau of the Census up to 1910. His estimate for 1920 was over by 1.58 percent; for 1930, under by 0.31 percent; for 1940, over by 3.53 percent; and for 1950, forty years after the last known population with which he worked, it was under by only 0.79 percent.

His method of estimating future population has several advantages over the other methods that have been referred to. First, it is based on the whole history of the community and not just on the last ten or twenty years. Second, it considers the nature of the economic opportunity in the community in question, instead of making a routine comparison with other communities whose growth may have been due to other factors. Third, it gives logical results when extended over considerable periods of time. It is limited, as are all the methods, by the fact that the same economic changes have a much greater relative effect on smaller communities than on larger ones. It is also limited by the fact that marked cultural changes may make necessary the use of a more complicated formula. However, in most cases it gives more accurate results than the other methods generally employed.

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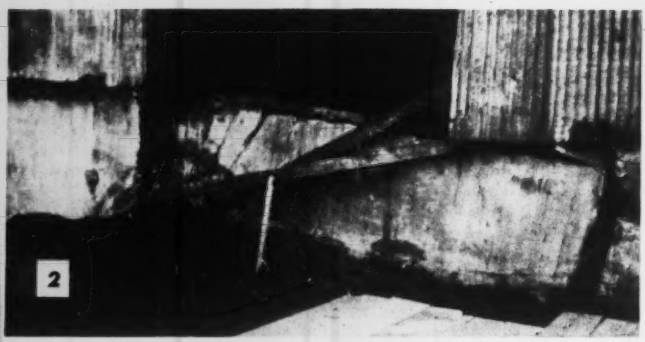
(The work on which this paper is based was done while the author was a graduate student at the University of Illinois under Prof. H. E. Babbitt, M. ASCE, of the Civil Engineering Department.)



(1) Damage on west, or bayou side, of mill included skewed and broken grade beams and broken piers, one of which had disappeared. At far left two columns hang several feet clear of their piers. Board road in foreground was constructed to support equipment used in test borings and foundation work. (2) At northwest corner of foundation, one grade beam cracked and broke away from its piers. Cracked pier on right was supporting most of damaged portion of structure. Drilling of holes for new piers was started at white stake near center of photo. (3) Holes of 30-in. diameter were drilled by auger

Foundation repair saves a Texas sawmill

The sawmill of the Kirby Lumber Corp., at Voth, Tex., was threatening to fall into Pine Island Bayou. The mill, built in the early twenties, had used the bayou as a millpond from which to lift logs to its headsaw. Although this arrangement was profitable from the start, the bayou exacted its toll in floods and continual washing at the soil on which the mill stands. Even though the washouts were filled with sawdust and waste over the years, part of the mill foundation began to settle. Finally, in a few months, this settlement accelerated to such an extent that the operating personnel became concerned for the safety of the mill. The extent of the foundation damage may be judged from the accompanying photographs.

At this time the firm of H. E. Bovay, Jr., consulting engineers of Houston, Tex., was retained to plan and supervise immediate repairs. The first action was to obtain soil borings to determine the footing necessary for a solid foundation. Plans were then drawn calling for eight new piers to be constructed just outside the damaged piers on the bayou side of the building. These new piers were to support one end of steel cross-beams, which would rest, at the other end, on footings on solid ground outside the slide area. A longitudinal beam resting on the cross beams would support the building columns, and replace the damaged concrete foundations, which would be removed. (See Fig. 1.)

A board retaining wall was to be erected on the inside face of the new piers, and on the outside of this wall, as much earth was to be removed from the slide area as feasible without disturbing the undamaged part of the foundation. Since the landslides were partially caused by alternate wetting and drying of the soil, the earth removed was to be replaced with sawdust, which would retain moisture without adding an excessively burdensome weight to the area subject to slides.

Drilled Footings Chosen

The relative advantages of drilled footings compared with driven piling were discussed with various contractors and representatives of the Kirby Lumber Corp. Either type of pier was capable of carrying the load, but there was a possibility that the vibration inherent in driving piles would accelerate the slide. Therefore cast-in-place concrete footings about 30 in. in diameter in drilled holes were decided on.

Drilling of the holes for the new piers was started at the light-colored

for cast-in-place concrete footings designed by author. Corrugated sheet-metal culvert was used for casing. (4) Six of eight new piers and beams placed to carry weight of sawmill are seen from mill's operating floor level. Note closeness of bayou. (5) Excavation of dirt to remove weight from slide area on bayou side of new piers was started as soon as building was trued up. Some obstructions encountered appear at right. Later dirt was replaced by sawdust, which would retain moisture without overloading slide area. (6) Completed job includes board retaining wall along inside of new piers.

R. J. BRENTZEL, Project Engineer for H. E. Bovay, Jr. Consulting Engineers, Houston, Tex.

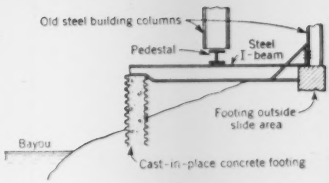


FIG. 1. Cross-sectional sketch (not to scale) shows arrangement used to replace damaged concrete column footings and concrete grade beams on bayou side of Voth Sawmill.

stake in the middle foreground of photograph No. 2 (facing page) and trouble was encountered at once. The rotten sawdust caved in, preventing the hole from holding its shape, and difficulty was encountered in dodging or chewing through logs and partially decayed boards. However, the paramount problem was the removal of the water which seeped in despite all attempts to exclude it.

Corrugated sheet-metal culvert was used for casing, and still the water seeped in. This difficulty was due to the lubricating properties of water, which made the drilling auger slick, so that the clay followed its spiral and slipped back into the hole instead of sticking to the bit and being lifted clear. The problem was finally solved by driving casing several feet into the clay and pumping out as much water as possible. Once seepage was stopped, the remaining water was absorbed by the clay and the hole was successfully completed to a depth of about 32 ft. Although similar problems were encountered in the remaining holes, all eight piers were successfully poured and their beams set.

In placing the casing, 4-ft sections were welded together and lowered as a 32-ft unit. Additional sections were then welded in place as required to obtain proper beam elevation.

Since the steel structure had settled as the foundation moved, it was necessary to cut off the lower part of the building columns to gain clearance for installing the new beams. This was accomplished by first setting the beams at the columns that were hanging free and, by means of large-capacity jacks, raising each column until it carried its share of the load. Adjacent beams and columns were handled in turn, and in this way the building was trued up and the lower part of the columns replaced.

Once the weight of the building was supported on the new piers, excavation of the dirt on the bayou side of the piers was started. The soil on the building side of the piers was sloped to remove as much weight as practicable, and the board retaining wall was erected along the inside of the new piers.

Messrs. A. W. Dainwood, operating manager, and S. F. Neal, master mechanic, represented the Kirby Lumber Corp., in handling the work. The writer, as project engineer for H. E. Bovay, Jr., consulting engineers, designed the drilled footings. Greer & McClelland did the subsurface exploration and laboratory work. The steel work was done by the Kirby Lumber Corp., and the foundation contractor was the Arrow Foundation Drilling Co.

EUGENE P. FORTSON, JR.
M. ASCE
Lt. Col., CE
Commanding 434th Engineer Construction Battalion

Korean bridge girders are

OPERATIONS of the Eighth United States Army in pushing Communist forces out of South Korea last spring required extensive rebuilding of railroad bridges by Army construction engineers. Structures over the principal Korean rivers the Naktong, the Han, and the Pukhan presented problems in erection profitable for study. The reconstruction of the bridge across the Han at Tanyang is unique among these because it had to be done without delaying military rail traffic, which was crossing on temporary repairs.

The Tanyang Bridge is of the deck girder type favored by the Japanese for railroad bridges throughout Korea. It spans the 1,250-ft channel of the Han River 70 ft above the river bed. Two girders and a pier at midstream were demolished in the withdrawal of our forces in the summer of 1950. Following our advance from the Pusan perimeter after the Inchon landing, the bridge was repaired with Oriental ingenuity by the Korean National Railroad, using temporary girders supported by crosstie cribs resting on sand-bag islands in the river bed. The demolished pier was rebuilt in April of 1951 by a contractor using native labor. The subject of this article is the erection of the permanent girders, accomplished a month later by a platoon of Company A, 434th Engineer Construction Battalion.

One girder, 85 ft long and weighing 50 tons, replaced a 65-ft girder weighing 30 tons, as well as a 20-ft span of four diaphragmed 20-in. I-beams. The other girder, 104 ft long and weighing 70 tons, replaced another 65-ft, 30-ton girder, and a 38-ft girder weighing 17 tons. The depth of the smaller of the permanent girders was 90 in., and that of the larger was 102 in.

Rail traffic across the bridge could not be interrupted for periods longer than could be offset by backlogging supply trains in forward rail yards. The Army G-4 considered 24 hours as the maximum gap that could be tolerated between trains. Consequently it was necessary to abandon earlier conventional plans for the girder launchings, and to replan operations so that the girders could be placed in two 24-hour periods.

According to the earlier plans, which allowed 96 hours for the girder launching, the girders were to be brought out on the bridge, jacked laterally and down onto falsework alongside their final locations, then jacked into position as the temporary girders were moved out onto other falsework that had been erected on the opposite side of the bridge. Finally, the temporary girders were to be jacked up to deck level and placed on trolleys for removal from the bridge.

The most direct method possible, in which the permanent girders were moved onto the bridge above their final positions and used as supports from which to lower the temporary girders from the bridge, was finally selected as the most expeditious. However, this method posed two critical problems the means of supporting the permanent girders while removing the temporary girders, and the methods of lowering the temporary girders past the supporting cribs. No special railroad bridge construction equipment was available, but the services of two locomotive cranes of 70-ton capacity could be secured for the launching operations.

Special end supports were fabricated of I-beam sections to hold the new girders temporarily above their final positions in the bridge while the old girders were being removed. These supports were bolted to the top flanges at the ends of the adjoining girders in adjacent spans and the new girders were placed on the cantilever extensions of the supports and held fast by hook bolts. (See Fig. 1.)

The supports had to be carefully designed because of the heavy loads they had to carry on their cantilevered ends during the erection procedure. The overlapping of the supports on the adjacent girders was limited by the reach of the booms of the locomotive cranes, and their vertical dimension was limited by the height of the trolleys on which the new girders were moved out on the bridge. Furthermore, a maximum moment of 2,000 ton-in., imposed by half the weight of the 70-ton girder plus three-fourths the weight of the 30-ton girder supported from it, had to be carried by bolts in tension. Web crippling of the I-sections was also critical, and called for extensive stiffening. Needless to say, great care was required in fabrication to secure perfectly plane surfaces at all areas of bearing.

Lowering the temporary girders from the bridge was complicated by the presence of the large crosstie cribs shown in the photographs. Preliminary planning considered demolishing these cribs after the temporary girders were suspended from the permanent girders, so that the former could be lowered with two sets of tackle, a less hazardous method than the single set of tackle that would have to be used if the girders were to be rotated to clear the cribs. However, the length of time that would probably be required to remove several thousand crossties, intricately dogged together, led to the decision to rotate the girders. Single-point suspension of the temporary girders offered the only practicable means of revolving them the 60 deg necessary to clear the cribs. (See Fig. 2.) Such suspension rendered the lowering a delicate maneuver, for the small clearance of 2 ft between the top of the temporary girders and the bottom of the permanent girders above, restricted the length of sling spacer bars to 7 ft.

Two locomotive cranes (photo far left) lower new 85-ft girder onto special end supports which will carry it until temporary construction below is removed. Operation is part of permanent reconstruction of bridge over Han River to replace temporary repairs carried out after Inchon landing. Permanent reconstruction included building of new pier, indicated by arrows, and erection of two new girders, one in span at each side of new pier. In photo at left, new 104-ft girder resting on special end supports (see Fig. 1) is used as base from which to lower old girder. Haul line of lowering tackle passes to crane out of photo at left. Following removal of old girders, new girder will be lowered into position by two locomotive cranes.

replaced on fast schedule

Launching operations for the 50-ton and the 70-ton girder were virtually identical, the single important exception being that the heavier girder was suspended from the crane tackle by eye-bars pinned to the end stiffeners of the girder, rather than by the cable slings used on the lighter girder. Every step possible was taken preliminary to the actual launching, such as drilling holes for end-support bolts, completely rigging the lowering tackle within the permanent girders, and fastening slings to the temporary girders. The 50-ton girder was placed first, because the crosstie crib in its span was deteriorating the more rapidly.

As soon after daylight as the railroad could be cleared on the day selected for launching, the new 50-ton girder on heavy-duty dollevs was hauled by locomotive from the Tanyang rail yard. When the girder was above its exact position in the bridge, two locomotive cranes were brought out on the bridge, one from each direction, as shown in a photograph. The girder was lifted by the cranes; the end supports were bolted in place; trolleys, track, and crossties were removed from the temporary girder, and the new girder was lowered to rest on the end supports. Tackle was fastened in turn to the slings around the temporary girder, a locomotive crane was backed away to handle the haul lines, and the temporary girder was raised, balanced, revolved, and lowered to cribbing previously placed in the river bed. When the locomotive crane had returned to its position for hoisting, the permanent girder was raised slightly, the special supports were burned away, and the girder was lowered to its final position. Ties and rail were immediately replaced so that the railroad could be reopened to use.

Launching of the second, 70-ton girder proceeded in the same way a few days later. Throughout all hoisting operations, preventer cribbing was used so that the heavy permanent girders could never fall a distance greater than 2 in. in case of tackle failure.

In spite of a clear-cut schedule and painstaking preliminary planning and preparation, many things occurred during the launchings to try the patience and test the skill of the engineer troops on the job. In hauling the 50-ton girder out to the bridge, a trolley axle broke, causing a two-hour delay while a crane was fetched and a new set of wheels installed. During the launching, the one-way-lay Japanese cable stretched under load, causing multi-part tackle to wind upon itself. A sheave froze in an improvised block, making it necessary to lower a 30-ton girder with tackle screaming and the entire bridge shuddering. And finally, the 70-ton girder was launched in a high wind with rainfall that measured 2¼ in. during the operation. That both launchings were accomplished in less than 22 hours, without damage to the bridge or injury to personnel, admittedly is due in part to the fortune that favors the bold.

The 434th Engineer Construction Battalion is a reserve organization which in its inactive status is affiliated with the Waterways Experiment Station at Vicksburg, Miss. Since coming on active duty in August 1950, it has served as a part of the 32d Engineer Construction Group, Col. Fremont S. Tandy, CE, commanding (M. ASCE).

FIG. 1. Special end support fabricated of I-beam sections was bolted to end of girder of contiguous span. New girder rested on protruding end of support, held fast by hook bolts, while old girder below was removed.

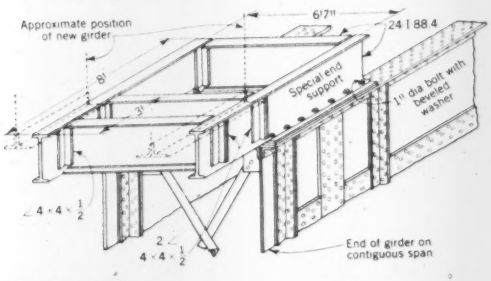
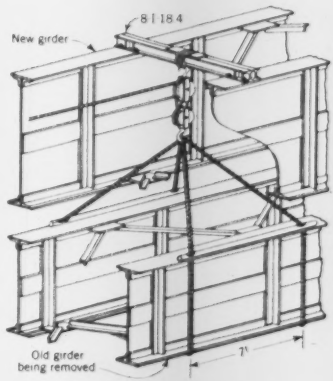


FIG. 2. Removal of old girder was effected by single-point suspension from new girder above while new girder was supported on special end supports shown in Fig. 1. By this means old girder could be rotated the 60 degrees necessary to clear cribs. Small clearance of 2 ft between top of old girder and bottom of new one made this maneuver a delicate one to carry out.



DONALD B. McKINLEY

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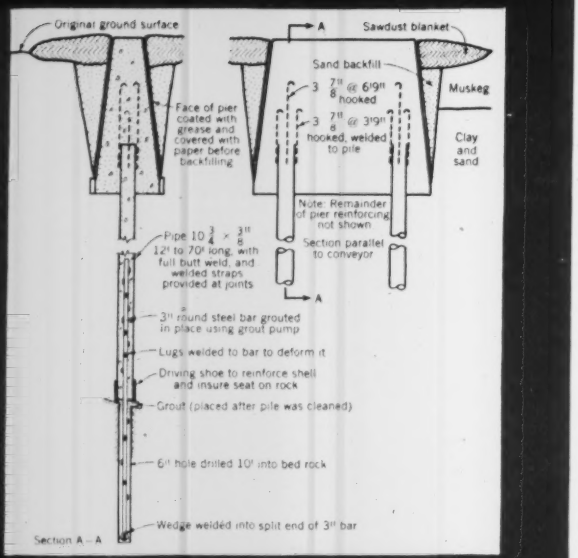
Original ground surface
A
Sawdust blanket
Sand backfill
3 7/8" @ 6'9" hooked
3 7/8" @ 3'9" hooked, welded to pile
Face of pier coated with grease and covered with paper before backfilling
Muskeg
Clay and sand
Note: Remainder of pier reinforcing not shown
Section parallel to conveyor
Pipe 10 3/4 × 3/8, 12' to 70' long, with full butt weld, and welded straps provided at joints
A
3" round steel bar grouted in place using grout pump
Lugs welded to bar to deform it
Driving shoe to reinforce shell and insure seat on rock
Grout (placed after pile was cleaned)
6" hole drilled 10' into bed rock
Wedge welded into split end of 3" bar
Section A – A

FIG. 1. Elevation of typical pier shows measures taken to prevent frost from heaving conveyor-belt foundations beyond allowable amount. Pier is anchored to rock, back-filled with sand which has low bearing capacity, insulated with sawdust, and greased. Sides are sloped as an additional means of minimizing load taken by bond.

Anchored foundation resists frost heave

Summer, so the residents jokingly claim, starts and ends on July 1 at Kapuskasing in northern Ontario, where the thermometer stays at zero during the winter, occasionally dropping to minus 40 or 50 deg F, and where the frost may penetrate 7 ft into the ground where unprotected by snow. Because of the sizable frost heave in this area, foundations must not only hold a structure up, but must also hold it down.

Kapuskasing is a modern town of five thousand people with another two or three thousand round about. During the war it was perhaps best known as a fueling stop for military planes and as an airport on the trans-continental run of Trans-Canada Airlines, but to its residents the all-important feature is the Spruce Falls Power and Paper Co. mill around which the town is built and upon which every resident directly or indirectly depends for his livelihood. The mill is about 600 miles north of Toronto, toward Hudson Bay, and is jointly owned by Kimberly-Clark Corporation and the *New York Times*, which takes about 60 percent of its capacity for newsprint.

In connection with the mill's logging operations, a button-cable type of conveyor was used for many years to haul the logs from the river or from sleds to stock piles during the short open-water season. Later the same conveyor transported the logs back to the rossers and choppers where the logs are debarked and chopped up in the first step towards pulp production. This simple 2,200-ft-long conveyor was not seriously affected by the heaving of its foundations due to winter frosts for it was essentially only a cable scraping along in a wood trough, and if a log was not carried along by one button of the cable, it was picked up by another. Considerable maintenance was necessary, but this and the poor efficiency were accepted as conditions caused by nature.

Because of the ever increasing demand for paper, it became necessary to increase the capacity of the mill. The first step obviously was the elimination of the principal bottleneck, the button conveyor. It was realized that a new modern belt-conveyor system, although more efficient, would not be able to sustain even a fraction of the movement that took place in the old conveyor foundations, since such movement would cause expensive wear of bearings and belts. The problem therefore was to design a "foundation in reverse." Whereas the usual foundation holds a structure up, this foundation would serve mainly to hold the structure down, against the heaving action of the frost.

Both European and American researchers have made numerous studies on the subject of movements and forces due to frost action. But the results of these studies have been merely qualitative, and no over-all solutions have been found. It is generally accepted that the expansion is much greater when water is contained in fine-grained soils such as silt or clay, where capillary action can take place, than in coarse sands and gravels where the normal expansion of water to ice is the only factor. As the soil at Kapuskasing

consists of muskeg (organic matter and clay) overlying clay and some silt and sand, the former condition was anticipated.

First discussions of the foundation problem centered around two general methods of attack. One method called for minimizing the bond between the foundations and the frozen ground. If piles were found necessary, they would consist of two concentric sections with a non-freezing filler in the annular ring. The concrete piers would then be carried below the frost line and the surfaces treated with a coating of grease or Paraffin. The second method anticipated reducing the bond area by installing small tubes of steel of the proper cross section, tied into the rock and carried above the surface of the ground before the concrete ties or billet plates were added. The latter tentative method was eliminated by the owner as undesirable because of the excess vibration which would result from the lack of mass in the foundation.

It was finally agreed that all piers must be anchored to the ledge rock with sufficient strength to withstand the assumed forces of heave. Where rock was 12 ft or less below the surface, the concrete piers were to be cast directly on the rock.

Where the depth to rock was more than 12 ft, the bottoms of the piers were carried 2 ft below the frost line and 10-in.-dia open-end pipe piles were driven the remaining distance to rock. A 3-in. dowell 20 ft long was anchored 10 ft into the rock as shown in Fig. 1. Though it was anticipated (based on meager boring information) that rock would be encountered at a maximum depth of 35 ft below grade, some of the piles were driven to a depth of over 70 ft.

The sides of the piers were sloped in at the top to reduce the unit load due to heave to be carried by the bond, and the concrete surfaces of the piers were coated with grease before backfilling with sand. Finally the area around each pier was blanketed with sawdust (a waste product in the town) for its insulating value.

Although the work was started in August, freezing weather soon arrived, bringing cold weather construction problems. A steam locomotive was the principal means of combating the elements. Its fire was never banked during the cold months and, moving on a track alongside the site, it provided steam to drive the piles, to heat the office, to blow out the material from the piles (the use of compressed air, the usual agent for cleaning such piles, was not practical because of the extreme cold), to thaw concrete aggregates, and to maintain reasonable temperatures while the concrete was setting, besides keeping coffee hot for the workmen. After such valiant service, this old horizontal tuber can retire with the grace of Man-of-War.

Drilling the dowel holes in the ledge rock was sublet to a local drilling contractor accustomed to surface mine drilling with diamond drills. The work was more difficult than originally anticipated for two reasons—the rock was deeper than expected, and its surface was extremely irregular and often shattered, making grouting necessary before the tools could be started. In reviewing the operation, the question arises whether the cable tool method of drilling might not have produced better average progress.

To test the tensile strength of the dowell, a typical hole was drilled in the ledge, close to where rock outcropped. Using a collar fastened to the dowel, which was designed to withstand 100 tons of uplift, a hydraulic tension load of 120 tons was applied with no indication of failure. Based on an assumed unit of bond on the surfaces of the concrete piers, the tensile capacity of 200 tons on two dowels was felt to be conservative, particularly since the surfaces of the concrete were treated to reduce bond stress.

Experience with the conveyor during winter weather in 1951 has shown, we hope, that this foundation is resisting uplift as was anticipated.

Spencer, White and Prentis, Inc., designed and constructed the foundation here described and was represented on the job by J. Muldowney. The owner's representatives included Messrs. R. Henson and C. W. Boast (chief engineer), of Kelly, Howe & Thompson.

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey

An eight-story, light manufacturing building was of brick-wood mill construction, that is, the beams and girders carrying the heavy plank flooring were supported by heavy timber interior columns and exterior brick bearing walls. Serious settlement of some of the columns occurred in some of the upper floors, and the city building department was on the verge of ordering that the building be vacated immediately. This would have involved considerable expense since many tenant firms were involved.

A careful inspection showed no general distress or weakness in any specific major member. It was apparent, however, that many of the columns had been cut an inch or two short at the time of erection, and that this deficiency had been remedied by the use of plank blocking. A safe and inexpensive remedy was found by the engineers investigating the problem. What would you have done in this situation? (For the solution adopted, see page 75.)

EDITOR'S NOTE: The above problem, for which we are indebted to Prof. H. J. Gilkey, M. ASCE, Head of the Department of Theoretical and Applied Mechanics, Iowa State College, is the first of a series drawn from actual experience and designed to demonstrate how one engineer overcame one of those bugs with which every engineer is familiar. Such experiences are an important part of an engineer's post-college education. Hoping that these problems will prove valuable to those who have never encountered them before and entertaining to those whose memories are thus drawn back to similar experiences of their own, the editors welcome contributions to this column.

Is research in reinforced concrete adequate?

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During the year 1950, something like 220 million barrels of cement were used in the United States. In the same period about 1½ million tons of reinforcing bars were used, or about 3¼ billion pounds. If, as a very rough estimate, 1 lb of reinforcing steel is considered to represent 60 cents worth of construction, then about 2 billion dollars worth of reinforced concrete was placed in this one year period. No civil engineer with a proper outlook on his profession can contemplate this figure without asking the question, "What are we doing to assure ourselves and our clients or employers that this billion-dollar business is being operated with a high degree of efficiency?"

What are we doing in the way of reinforced concrete research? Although a list of all the research in this field now under way throughout the world would be rather impressive, to most large scale industrial operators, the annual cost would seem a very small percentage of the 2-billion-dollar yearly expenditure for this type of construction.

A list which I recently compiled of the reinforced concrete and prestressed concrete research projects being conducted in the laboratories of our colleges and universities included 35 such projects, dealing with such matters as the distribution of stress in reinforcing bars, tests of a model reinforced concrete frame, shear and diagonal tension in beams, determination of elastic properties of reinforced concrete beams, and effects of plastic flow on prestress. Other investigations are being carried out by such organizations as the Corps of Engineers, Bureau of Reclamation, American Iron and Steel Institute, Portland Cement Association and others.

Laboratories in England, France, Sweden, Switzerland, and other European countries are also engaged in reinforced concrete research. As an example of the international aspect of this problem, the question of the distribution of compression in a reinforced concrete beam is currently being, or has been recently, investigated in four different laboratories—two in this country, one in England, and one in France—and each of the four is attacking the problem by a different method.

This survey of reinforced concrete research is necessarily far from complete. For one thing, the great amount of analytical and drafting-board research which is continually going on is not included, important as it is, simply because no statistics on it are available.

As to the question, what use are we making of our research findings? it is my belief—and I will not try to prove it—that we are not making full use of them. Although a limited number of designers are always on the alert to apply new findings, a large number never go beyond the Joint Committee Code of Recommended Practice, which has not been revised in the past 11 years.

Research Council Organized

Much of our reinforced concrete research is futile because it is misdirected. Only rarely are a research expert and a competent designer combined in the same man. Usually the researcher fails to comprehend the designer's problems, and the designer is unaware of the ways in which research can help him. An important part of the solution of the problem lies, then, in getting these two groups together. Some industrial organizations in the steel and concrete fields are making a considerable effort to do just that. In 1948 the Reinforced Concrete Research Council was organized with closer collaboration as one of its main objectives.

The Council was organized largely through the efforts of the late A. J. Boase, M. ASCE, at that time chairman of the Masonry and Reinforced Concrete Committee of the Structural Division of ASCE, and the late Boris Bakhmeteff, Hon. M. ASCE, then chairman of the Research Committee of ASCE.

Its purpose was stated as "to place reinforced concrete design on a more scientific basis." More explicitly:

> The purpose of the Reinforced Concrete Research Council is to stimulate, guide and assist in financing research in the field of reinforced concrete and to make available the results of such research, to organize and administer cooperative research projects, and in cooperation with technical committees to interpret research results in the form of recommendations for the design of concrete structures.

The Council operates in close collaboration with various committees of ASCE and ACI, and its activities are sponsored by The Engineering Foundation. The present membership is 17. Funds for research projects sponsored by the Council have come from The Engineering Foundation, the Research Corporation, and several industrial organizations and government agencies. Three universities also have contributed funds or have furnished other assistance.

Projects Now Under Way

The first project was an investigation of the ultimate strength of eccentrically loaded columns, involving the testing of 90 square and 30 cylindrical columns. The final report on this research, conducted at the University of Illinois and approved by the Council, has been issued as a University Bulletin. As an extension of this project, tests are now under way at the University on 40 additional columns, 20 of which will be subjected to high sustained loads. Loadings near the ultimate strength, as found

from the short-duration tests, will be continued for months in order to determine the capacity of the columns to carry these loads indefinitely.

At the Virginia Polytechnic Institute a project is now being carried out to determine the accuracy of present methods of designing rigid-frame bridges, in cooperation with ACI Committee 314, on Rigid-Frame Bridges. Current tests of a small aluminum model will be followed by tests on a small-scale reinforced concrete model.

An investigation of shear and diagonal tension in reinforced concrete beams has been completed at the University of Illinois, and the report was released in October 1951. This investigation included the testing of 60 beams with various steel percentages and three concrete strengths. The Bureau of Public Roads is cooperating with the Council in this research.

In another project, called the "Tensile Crack Exposure Test," concrete beams containing various percentages of reinforcement and subjected to sustained bending loads by means of springs, are undergoing severe climatic exposure at Treat Island, Maine. This project is being carried out as a part of the Civil Works Investigation Program of the Corps of Engineers, U. S. Army.

The most recent project accepted for Council sponsorship, in cooperation with the Bureau of Public Roads, is an investigation at Ohio State University of the distribution of compression in reinforced concrete beams, particularly as failure is approached. A considerable amount of experimental work had been conducted previously at the University. The Bureau of Reclamation Laboratories has also devised a method for the direct measurement of stress in the compression zone of a beam, and the results of its first test will soon be submitted to the Council.

In all this research engineers are demonstrating their realization that the problem of designing reinforced concrete structures with maximum economy consistent with safety has not yet been satisfactorily solved. It is believed that the work now being sponsored by the Reinforced Concrete Research Council is a long step in the right direction.

(This article was originally presented by Mr. Blanks at the ASCE Annual Convention, before the Structural Division session presided over by Jewell M. Garrelts.)

Water from Pacific Northwest for deserts of Southwest

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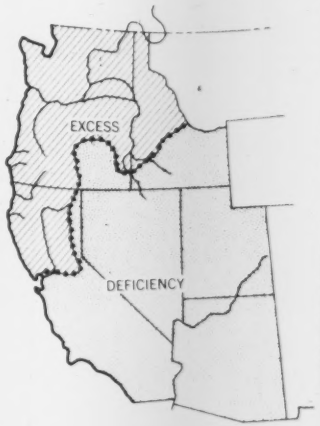


FIG. 1. Basin-wide water supply exceeds ultimate consumptive requirements in area marked "excess" and falls short of requirements in area marked "deficiency."

Local supplies of municipal, industrial, and irrigation water for large areas throughout the western United States are being developed at a rate which will complete their full exploitation within a much shorter time than is generally realized. As local surface supplies are fully utilized and ground-water reserves exhausted, expansion or even maintenance of the developed economy will depend upon some new or imported supply.

In many localities, full utilization of all local sources can be foreseen in the not-far-distant future. In fact, for some parts of Arizona and California, and in certain sections of other states, the limit of local water resources already has been exceeded; land formerly irrigated is idle, and expansion of industry has been impeded because of the inadequate water supply. As time goes on, these shortages will increase, finally becoming widespread unless corrective measures can be taken.

In contrast to this impending general scarcity and existing localized shortage, there are enormous water resources in the streams of other sec-

tions, particularly in the coastal belt of northern California and elsewhere in the Northwest. The area of basin-wide excess of water supply over ultimate consumptive requirements, and the area of deficiency, are shown in Fig. 1.

In the fall of 1948, the U. S. Bureau of Reclamation initiated the United Western Investigation to determine what surpluses over ultimate local needs might exist in streams of the Northwest and, if any such surpluses were found, to appraise the feasibility of transferring some of the excess water to areas with deficient supply. The first report of these investigations has been approved by the Bureau of Reclamation and is before the Secretary of the Interior for signature.

This investigation is a long-range reconnaissance of the entire West, with the objective of determining whether prospects for large-scale inter-basin water transfers are sufficiently attractive to warrant further investigation. For a part of the Southwest, including sections of California, Arizona, Nevada, and possibly other states of the Colorado River Basin, this objective has been attained. It has been demonstrated that a large quantity of water can be imported to those regions from the Northwest by works well within the scope of current know-how, at a per-acre cost lower than that which many water users in the area concerned are now paying.

The current interim report provides the information required for an understanding of the problem of deficient water supply which will soon confront the western states, and suggests possible works for solving that problem. The combined magnitude of the contemplated engineering works exceeds that of any project ever constructed. In any scheme of such scope, interrelation and conflict among many varied interests is inevitable. At the outset the report therefore states certain principles which were adhered to in its preparation in order to avoid any misunderstanding as to the intent and findings of the investigation. These principles bear repetition here:

The report does not seek authorization for construction of any phase of a water storage or transfer development; in fact, it clearly indicates that such a recommendation should not be made at this time.

The investigation has covered, in varying degrees of thoroughness, numerous general plans, many possible routes for conveying water, numerous possibilities for exchange to effect water supply transfer, as well as other alternatives and combinations. For the purpose of analysis, one plan to serve the Southwest is presented in more detail than the others. This does not mean that that plan is the best or only plan, or even an average plan. It does not mean that all of the interested parties would be willing to participate, as has been assumed. The plan is presented strictly as a model for the purpose of illustrating physical and economic possibilities.

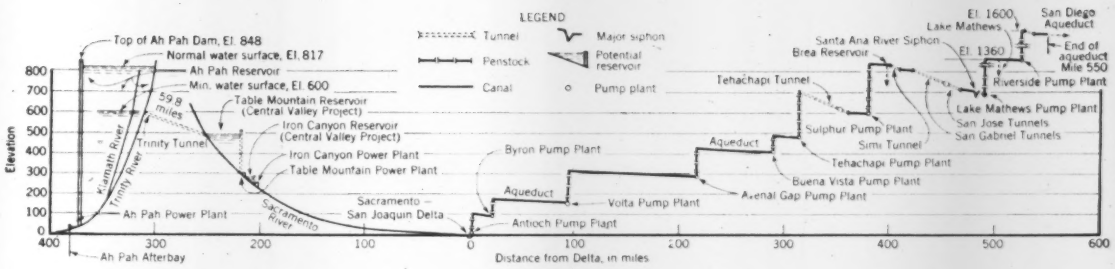
The report adheres closely to these considerations of engineering feasibility and economic justification. This is not intended to ignore or deny the many related considerations such as those concerning water rights, compacts, state laws, fish interests, recreation, and others. The scope of the report at this stage does not cover these admittedly difficult problems which are inherent in any prospective development. Full consideration of those problems should be given as the investigation proceeds in cooperation with other agencies concerned.

FIG. 2. Dam at mouth of Klamath River is suggested for possible construction two or three decades hence to divert 9,175 cfs now wasted to Pacific Ocean. Concrete structure 800 ft high would divert water through 60-mile gravity tunnel to Sacramento River below Shasta Dam, whence it would continue to flow by gravity more than 200 miles down Sacramento channel.

FIG. 3. After its arrival in Sacramento–San Joaquin delta by route shown in Fig. 2, water from Klamath River would be lifted by successive pumping plants for some 600 miles further south, according to suggested plan. It would flow through canals and tunnels as far south as San Diego, with diversions en route. This 3¼-billion-dollar project, at present advocated only for further study, could provide water for more than two million acres of new land in Southwest.

At the start of the investigation about three years ago, consideration was first given to basic factors applicable to the entire West. Verification of the vast water resources believed to exist in Northwestern streams was the first objective. A study was made of the maximum possible water requirements which could arise throughout the Northwest under conditions of ultimate full development, to determine what part, if any, of the vast outflow would remain as surplus under those conditions. Irrigation was assumed for all lands which could conceivably be farmed by this means. The inventory made of all such lands listed about 25 million acres.

The volume of water used by cities and industries ordinarily is small as compared to that used for irrigation, but estimates were made for the maximum consumption that could result from a tenfold increase in population and from the industrial requirements which would accompany such growth.



Preliminary studies were made of mineral and other natural resources which would call for special quantities of water in processing. All these estimates were made with the advice of locally recognized specialists and were purposely made much larger than was believed likely so as to anticipate the absolutely maximum future water use.

The maximum possible future consumption in the Northwest so estimated was dwarfed by the surplus, which would be about four times as great. In round numbers, it was found that about 240 million acre-feet per year of water from Northwestern streams would be wasted to the sea, even under conditions of full development. Actually this surplus would amount to about three times that consumed in irrigating all the irrigable lands in water-deficient areas west of the Continental Divide, and in satisfying, at the same time, all other foreseeable water needs of the West.

Next an inventory was made of the potential demands for water in the parched sections west of the Divide, following the same procedure used to estimate water needs in the Northwest. However, normal use was assumed, and not maximum possible use as in the Northwest. Another 25 million acres were found physically susceptible to irrigation. Thus the increase in irrigated area ultimately could approach 50 million acres. This is two or three times the new area heretofore thought irrigable, and it is now evident that in Northwest streams there is an abundance of water to serve such lands if future economic conditions warrant the necessary expenditure.

It is recognized that although large quantities of water may always remain surplus in the Northwest, a major part of such surplus might be in use for the generation of power by the time a United Western project was initiated. If even a small quantity of water were exported above points of power generation, the electrical output would of course decrease proportionately. For the study it was assumed therefore that a United Western project would make energy available to offset impairment to the then existing plants, in the same way it would meet its own pumping power requirements.

The most critical existing water shortages and imminent potential shortages are found in the Southwest, and consequently attention was first directed to that region. Many schemes were given consideration, with varying degrees of thoroughness. Some were rejected as impracticable on cursory examination; others were found to be defective only after lengthy study. A few plans remained as possibilities. One of these, designated in the report as the Northern California Diversion, shown in Fig. 2, was selected as a model and subjected to complete reconnaissance analysis. This plan derives its water supply from the Klamath River in northern California. Contrary to widespread belief, it would not tap the Columbia River, although it could be extended to that stream by physically practicable means, should future needs warrant the additional cost. The Columbia offers a vast water source for possible development in the distant future, but meanwhile the Klamath, Rogue, Umpqua and other streams are closer to the potential demand, cheaper to develop, and undoubtedly adequate for a great many decades.

Klamath River Source

The typical plan presented in the report, and represented in plan and profile in Figs. 2 and 3, contemplates an 800-ft dam at the mouth of the Klamath. The reservoir so created would conserve some 6,000,000 acre-ft per year of water which now flows into the ocean. The lake would back up the Trinity River, a tributary of the Klamath, above the inlet of a 60-mile tunnel by which the conserved water would be exported by gravity into the Sacramento Valley at a point below Shasta Dam. The flow would then follow the natural channel of the Sacramento River, passing through power plants at Table Mountain and Iron Canyon.

At the Sacramento–San Joaquin delta, 750,000 acre-ft per year would be released to serve areas north and south of San Francisco Bay. The remainder would be pumped into a new conduit running southward along the west side of the San Joaquin Valley. Water sources naturally tributary to the Central Valley, even if fully regulated and not exported, are inadequate to serve all the irrigable land in that valley. Therefore releases would be made in the San Joaquin Valley for irrigation of about $1\frac{1}{2}$ million acres of high-grade land for which there can never be water from Central Valley sources. A tunnel westward through the Coast Range would provide about 150,000 acre-ft per year to the central California coast. Also, 100,000 acre-ft per year would be released on the Central Valley floor to lands irrigated by the American River; in exchange, a like amount from high elevations on that stream would be diverted eastward into Nevada.

At Bakersfield, the main conduit would pierce the Tehachapi Mountains and deliver about $1\frac{3}{4}$ million acre-ft per year to the Santa Barbara–Los Angeles–San Diego area. This would include 300,000 acre-ft per year of Klamath River water supplied to the city of Los Angeles in exchange for Owens River water, which could then be used on lands in the Mojave Desert. It would also include slightly more than a million acre-ft

per year supplied to the service area of the Metropolitan Water District in exchange for the release of a like quantity in the Colorado River. The destination of the released Colorado River water is not specified in the report, but one possible area is in central Arizona.

It is important to note that the report remains timely regardless of the legal outcome of the California-Arizona water controversy. If California's position prevails, there could be simply an exchange, in southern California, of Klamath River water for Colorado River water. If Arizona's position prevails, California would find such a project still more advantageous. In either case, the physical plan would be identical, and both parties would receive water. The Colorado River Aqueduct would remain as a stand by to supply the vital needs of the city of Los Angeles in emergency.

The plan would be in harmony with other developments now being proposed by the U. S. Bureau of Reclamation and other agencies. It has been assumed, for example, that the works for the proposed Trinity River diversion of the Central Valley plan will have been built. This diversion will be needed many years before the major Klamath River development, and should be considered as a separate undertaking.

The total cost of the project, including construction, maintenance, operation, replacement reserve, and interest at $2\frac{1}{2}$ percent on the full unretired balance of all project debt, would be $89,000,000 per year for 100 years. This ignores any credit from power or other benefits, and anticipates no subsidy of any kind. Figured at the time construction would start, the "cash-in-advance" capital cost equivalent to this annual cost would be about $3\frac{1}{4}$ billion dollars.

If all these project costs were to be amortized solely by the delivery of water, again including interest at $2\frac{1}{2}$ percent on all unretired debt and ignoring power credits or any other benefits, the cost to the Government would be $25 per acre-ft delivered to the farm headgate or, for municipal water, to the wholesale delivery point. This computation provides for carrying charges on the project debt for an assumed period of 15 years during construction and market development before full water delivery would be made.

Many water users, of course, pay only a fraction of this amount for service because their systems are naturally endowed with favorable characteristics and, in some instances, the cost of service may be almost nothing. But the day of these low-cost and easy developments is very largely in the past. With water as well as other commodities, the concept of value changes with increasing scarcity. As supplies become more expensive, they tend to be used more efficiently, on the better lands, and on more lucrative crops.

For 16 water users' organizations in the area to be served by the plan outlined in the report, the cost of service now varies from $11 to $65 per acre-ft, and averages about $30 per acre-ft—somewhat more than the cost under the United Western project. Furthermore, under present principles of reclamation law, irrigators would not be charged for all the elements of cost mentioned earlier, particularly the interest item. Computed on this basis, the price to irrigators would be much lower that $25 per acre-ft. The rate would be comparable to that on other Bureau of Reclamation projects where the price to irrigators is relatively high.

The plan would provide water for a total of more than 2 million acres of new land and supply $1\frac{1}{2}$ million acre-ft per year for domestic use, supplemental irrigation, and other purposes. A large surplus of power early in the life of the project, while water-markets would be growing and project pump loads consequently would be undeveloped, would create a monetary credit from power generation. This would be equivalent to a surplus of $4,000,000 per year throughout the life of the project. The sum of all project benefits is estimated at $170,000,000 per year, and the ratio of benefits to cost is thus nearly 2 to 1.

It is not possible to say how soon a project such as that described would be warranted. It is most certainly not advocated for construction at this time, and the report makes this point abundantly clear. It is pertinent, however, to emphasize certain aspects of the time factor. Detailed planning and design of such a project in a manner adequate for Congressional authorization would require many years; at a normal rate of progress, a decade might be needed. The report estimates 20 years for the construction period. Thus it might be three decades before water could be made available in southern California, even after the preliminary work had been completed. With a population growth in the Southwest of more than 40 percent in the last decade, it appears that the investigational stages of this undertaking are certainly timely. It is none too soon to recognize the problem and bring it to public attention. Within a few years it may prove necessary to adopt a greatly accelerated program in order to keep pace with water requirements.

The typical plan described as the Northern California Diversion would not by any means constitute a complete water supply for the Southwest. It would meet the most imminent demands and could stand as a complete and final project, but it would more probably constitute the initial stage of a larger plan to serve much wider markets as future economy might dictate. Studies indicate that supplements and extensions could provide a large additional volume of water. Generally speaking, such extensions would involve the tapping of more remote sources such as the Rogue, Umpqua, and Smith Rivers, and would be progressively more expensive.

Apart from this plan to serve the Southwest, there are numerous possibilities for inter-basin transfer of supplies into other water-deficient areas. Studies of other possible transfers are as yet in the preliminary stages; hence it was practicable in the report only to enumerate the various potentialities thus far encountered. These involve deliveries to 12 states and contemplate both irrigation and municipal use.

In general, the United Western Investigation represents an extension of the normal trend in the planning of water developments. Originally, planning embraced only a simple project. With wider need for water, the concept grew to include whole streams, and then was expanded to embrace entire river basins, the planning for which is now accepted practice. Beyond this, numerous isolated inter-basin transfers of water have been accomplished as in the case of the Colorado–Big Thompson project. The United Western Investigation represents an extension of this inter-basin concept.

At the present time, various agencies anticipate the expenditure, over a considerable period, of many billions of dollars for the construction of water supply projects of a generally localized, or at the most, basin-wide nature. A broad, long-range plan, such as that to which the United Western Investigation is directed, will enable much greater efficiency in the design of individual projects and will permit the integration of such projects in an over-all pattern as natural conditions will ultimately demand.

"Normal" size distribution found in samples of river-bed sand

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AMONG river engineers and petrographers there is a fairly general belief that the distribution of sizes within river-bed samples follows a definite law common to some range of sample mean sizes. In fact, petrographers have adopted logarithmic probability paper for plotting the "percentage coarser than" curves that engineers plot to ordinary or semi-log scale when analyzing soils and aggregates. Their reason is that the plotted points, on this kind of paper, fall on approximately straight lines; and the implication is that the logarithm of particle size is distributed approximately according to the "normal law of error."

The concept of the "normal law of error" may be explained very briefly as follows. The measurements of certain natural quantities are found to be distributed about their means in a special symmetrical pattern, so that the frequency of occurrence of measures that deviate by an amount x from the mean is proportional to

$$e^{-x^2}$$

Examples are: (1) errors of precision observations, as in surveying; (2) deviations of sizes of manufactured items; (3) examination marks in classes; (4) heights of men in regiments. As this kind of distribution is common, and the mathematicians have been able to deduce its occurrence from a variety of postulates about the nature of the causes of deviation from mean, it has come to be known by the rather unfortunate name of "normal distribution," in spite of the fact that there is nothing particularly normal about it.

Of course, in the absence of a good reason, it is just as wrong to assume that scattered data must follow the normal law as to assume that ordinary experimental data must plot on a straight line, but it is always a good idea to try for a normal law just as for a straight line. "Probability paper" makes the work the same in both cases; it is merely paper whose frequency scale has been distorted so that if the size of the measured quantity is plotted against "frequency of occurrences greater or less than," and if the normal law holds, then a straight line will result. Logarithmic probability paper uses logarithms vertically instead of ordinary quantities. Other papers are not manufactured, but there is no reason why an investigator should not use vertical scales of squares, cubes, or any function that he suspects might be distributed normally.

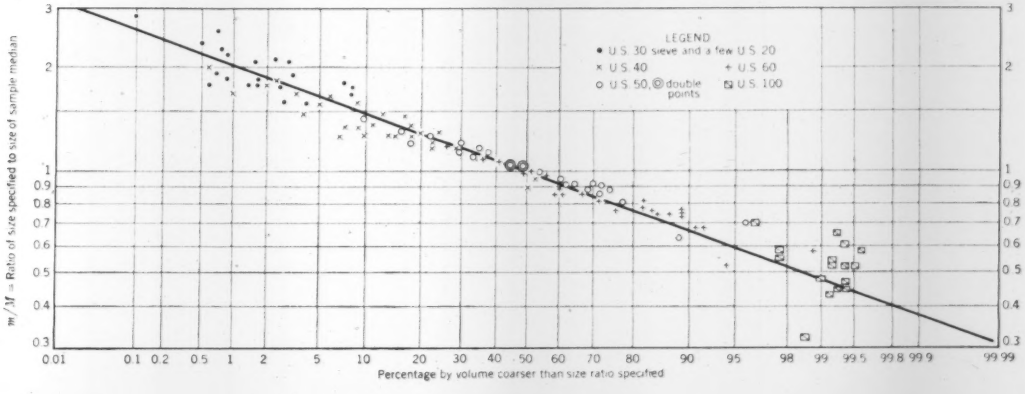
Recently the writer had access to river-bed sand data collected by the National Research Council of Canada. To get all the samples on one sheet of logarithmic probability paper, and test for a universal distribution law, the sand size was made nondimensional by dividing each size by the mean size of the sample to which it belonged. The plot of relative sand size against "percentage by volume coarser than" is shown in Fig. 1, and indicates remarkable agreement with the normal distribution. The qualification "by volume" is believed, from tests, to be equivalent to "by weight," but sizes found by sieving will differ, generally, from those found by settlement.

The sample mean sizes ranged from 0.21mm to 0.47mm, with one exception of 0.096 mm that fitted the line very well. Most samples contained all sizes from U.S. standard sieve 30 to 100, i.e., 0.59 mm to 0.105 mm, and several contained considerable amounts of U.S. 20 and U.S. 140.

If the normal distribution of the logarithm of relative particle size is established over a range, the following advantages, among others, accrue:

1. Investigators can concentrate on finding reasons for the law, and cease speculating on its nature.
2. River sands can be used with assurance in sediment-transport experiments, instead of uniform sands that do not occur in nature, since the distribution is implicit in mean diameter and is not an added complication.
3. River-model builders and flume experimenters have a means of deciding whether the sand they use is of river-bed type.

FIG. 1. DIMENSIONLESS size distribution is plotted for two sand samples taken from each of 15 section lines at two-mile intervals from Strait of Georgia up Fraser River, B.C., Canada.



Two nomographs developed for trapezoidal channels

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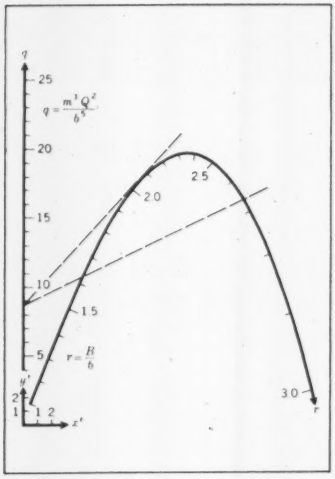


FIG. 1. Nomograph for critical depth and hydraulic jump.

HYDRAULIC DESIGN of trapezoidal channels entails much routine work which might be simplified by the use of nomographic charts. Two such charts are here developed—one for determining critical depth, the other for determining the depth of uniform flow. The critical depth chart can also be used for determining conjugate depths in the event of a hydraulic jump. While neither chart is universal, they should both prove adequate for the usual design problem. For the occasional data that fall outside their range, additional charts can be similarly constructed.

Critical Depth and the Hydraulic Jump

The generally accepted equation for conjugate depths in a hydraulic jump is

$$h_1 A_1 + Q^2/gA_1 = h_2 A_2 + Q^2/gA_2 \quad (1)$$

where the subscripts 1 and 2 correspond to the respective cross sections upstream and downstream from the jump, while

Q = discharge rate, in cfs
A = cross-sectional area, in sq ft
g = 32.174 ft per sec²
h = distance from free water surface to centroid of cross section, in ft

For a trapezoidal section,

$$A = 0.5d(b + B) \quad (2)$$

$$hA = (d^2/6)(2b + B) \quad (3)$$

$$B = b + 2md \quad (4)$$

where

d = depth, in ft
B = width at water surface, in ft
b = bottom width of channel, in ft
m = side slope of channel

From Eq. 4, it follows that

$$d = (B - b)/2m = b(r - 1)/2m \quad (5)$$

where

$$r = B/b$$

From Eq. 5, Eqs. 2 and 3 become

$$A = b^2(r^2 - 1)/4m \quad (6)$$

$$hA = b^3(r - 1)^2(r + 2)/24m^2 \quad (7)$$

whence Eq. 1 reduces to

$$\phi(r_1) + q/\theta(r_1) = \phi(r_2) + q/\theta(r_2) \quad (8)$$

where

$$q = m^3 Q^2/b^5$$
$$\phi(r) = g(r - 1)^2(r + 2)/96$$
$$\theta(r) = r^2 - 1$$

In determinant form, Eq. 8 becomes

$$\begin{vmatrix} q & 0 & 1 \\ -\phi_2 & 1 & 1/\theta_2 \\ -\phi_1 & 1 & 1/\theta_1 \end{vmatrix} = \begin{vmatrix} q & 0 & 1 \\ -\phi_2\theta_2 & \theta_2 & 1 \\ -\phi_1\theta_1 & \theta_1 & 1 \end{vmatrix} = 0$$

from which the following nomographic coordinates can be deduced:

$$x_q = 0 \qquad y_q = q$$
$$x_r = \theta(r) \qquad y_r = -\phi(r)\theta(r)$$

To obtain a practical chart for $1 < r \leq 3$, it becomes expedient to define the rectangular coordinates, as follows:

$$x' = 2.5x; \qquad y' = 7.0x + y$$

Figure 1 is then constructed from the data presented in Table I. For a different range in r, a similar chart might be obtained by altering the coefficients of x in the equations for x' and y'. In the use of Fig. 1, it can be shown that when the side slopes are unequal, m can be taken as the average of the two.

Depth of Uniform Flow

On the basis of Manning's formula, the equation for uniform flow may be written,

$$Q = A(1.486/n)(A/P)^{2/3} S_0^{0.5} \quad (9)$$

where, in addition to the symbols previously defined,

P = wetted perimeter of section, in ft
S_0 = slope of channel bottom
n = coefficient of channel roughness

For a trapezoidal section

$$A = md^2 + bd = md^2(1 + u) \quad (10)$$

$$P = b + 2(m^2 + 1)^{0.5} d = b(1 + 2M/u) \quad (11)$$

where

$$u = b/md$$
$$M = (m^2 + 1)^{0.5}/m$$

For the combination of Eqs. 9 through 11, it can be shown that

TABLE I. Data for construction of Fig. 1

r	x_r	$-y_r$	x'	y'
1.1	0.21	0.00	0.53	1.5
1.2	0.44	0.02	1.10	3.1
1.3	0.69	0.07	1.73	4.8
1.4	0.96	0.18	2.40	6.5
1.5	1.25	0.37	3.12	8.4
1.6	1.56	0.68	3.90	10.2
1.7	1.89	1.15	4.73	12.1
1.8	2.24	1.83	5.60	13.9
1.9	2.61	2.76	6.52	15.5
2.0	3.00	4.02	7.50	17.0
2.1	3.41	5.68	8.53	18.2
2.2	3.84	7.78	9.60	19.1
2.3	4.29	10.4	10.73	19.6
2.4	4.76	13.8	11.9	19.5
2.5	5.25	17.8	13.1	19.0
2.6	5.76	22.8	14.4	17.5
2.7	6.29	28.6	15.7	15.4
2.8	6.84	35.6	17.1	12.3
2.9	7.41	43.9	18.5	8.0
3.0	8.00	53.6	20.0	2.4

TABLE II. Data for construction of Fig. 2

u	x_u	y_u	x_u'	$-y_u'$
0.4	0.992	0.00	3.97	3.97
0.5	0.989	0.01	3.95	3.94
0.6	0.978	0.01	3.91	3.90
0.7	0.966	0.02	3.87	3.85
0.8	0.951	0.04	3.81	3.77
0.9	0.932	0.06	3.73	3.67
1.0	0.911	0.09	3.64	3.55
1.1	0.886	0.12	3.55	3.43
1.2	0.862	0.17	3.45	3.28
1.3	0.836	0.21	3.34	3.13
1.4	0.808	0.27	3.23	2.96
1.5	0.779	0.33	3.11	2.78
1.6	0.750	0.40	3.00	2.60
1.7	0.721	0.47	2.88	2.41
1.8	0.693	0.55	2.77	2.22
1.9	0.665	0.64	2.66	2.02
2.0	0.638	0.72	2.55	1.83
2.1	0.611	0.82	2.44	1.62
2.2	0.586	0.91	2.34	1.43
2.3	0.562	1.01	2.25	1.24
2.4	0.538	1.11	2.15	1.04
2.5	0.515	1.21	2.06	0.85

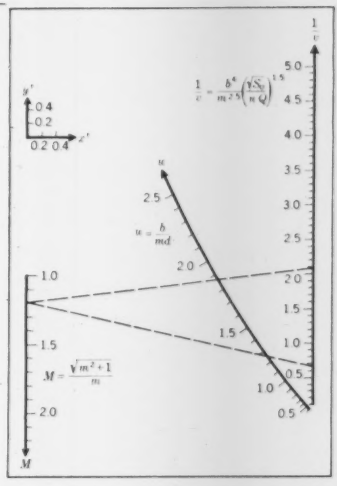


FIG. 2. Nomograph for depth of uniform flow.

$$K^{1.5}\, b\,(1 + 2M/u) = 1.811(b^2/m^{2.5})\,(1 + u)^{2.5}/u^5 \qquad (12)$$

where

$$K = nQ/S_o^{0.5}$$

Equation 12 reduces to

$$uv + 2Mv = \phi(u) \qquad (13)$$

where

$$v = m^{2.5}\,K^{1.5}/b^4$$
$$\phi(u) = 1.811\,(1 + u)^{2.5}/u^4$$

In determinant form, Eq. 13 becomes,

$$\begin{vmatrix} u & \phi & 1 \\ 1 & v & 0 \\ -2M & 0 & 1 \end{vmatrix} = \begin{vmatrix} u\,(1+\phi) & \phi\,(1+\phi) & 1 \\ 1/v & 1 & 1 \\ -2M & 0 & 1 \end{vmatrix} = 0$$

from which the following nomographic coordinates can be deduced:

$$x_u = \phi\,(1 + \phi); \quad y_u = u\,(1 + \phi)$$
$$x_v = 1; \quad y_v = 1/v$$
$$x_M = 0; \quad y_M = -2M$$

To obtain a practical chart for $0 < u < 3$, it becomes expedient to define the rectangular coordinates as follows:

$$x' = 4x; \quad y' = y - 4x$$

Figure 2 is then constructed from the data presented in Table II. For a different range in u, a similar chart might be obtained by altering the coefficients of x in the equations for x' and y'.

In the use of Fig. 2, it can also be shown that when the side slopes are unequal, m can be taken as the average of the two for the scales of u and v. For the M-scale, however, M itself becomes

$$\frac{(m_1^2 + 1)^{0.5} + (m_2^2 + 1)^{0.5}}{m_1 + m_2}$$

Should the inequality of side slopes be associated with a variation in channel lining, the value of n for the v-scale becomes ambiguous.

Illustrative Problems

To demonstrate the use of Figs. 1 and 2, let $m = 1.5$; $b = 12.0$ ft; $S_o = 0.001$; $n = 0.020$; and $Q = 800$ cfs.

Example 1. To find the critical depth, compute

$$q = m^3Q^2/b^5 = 1.5^3 \times 800^2/12^5 = 8.69$$

On Fig. 1, lay a line through $q = 8.69$ tangent to the r-curve to obtain $r = 2.07$. Then compute

$$d = b\,(r - 1)/2m = 12\,(2.07 - 1)/2 \times 1.5 = 4.28 \text{ ft, the critical depth}$$

Example 2. To find the conjugate depth for $d_1 = 2.50$ ft, compute

$$B_1 = b + 2md_1 = 12 + 2 \times 1.5 \times 2.5 = 19.5$$

$$r_1 = B_1/b = 19.5/12 = 1.63$$

On Fig. 1 lay a line through $q = 8.69$ and $r_1 = 1.63$ to obtain $r_2 = 2.66$. Then compute

$$d_2 = b(r_2 - 1)/2m = 12(2.66 - 1)/2 \times 1.5 = 6.64 \text{ ft, the conjugate depth for 2.50 ft.}$$

Example 3. To find the depth of uniform flow, compute

$$M = (m_2 + 1)^{0.5}/m = (1.5^2 + 1)^{0.5}/1.5 = 1.20$$

$$1/v = (b^4/m^{2.5})\,(S_o^{0.5}/nQ)^{1.5} = (12^4/1.5^{2.5})\,(0.001^{0.5}/0.02 \times 800)^{1.5} = 0.66$$

On Fig. 2, lay a line through $M = 1.20$ and $1/v = 0.66$ to obtain $u = 1.26$. Then compute

$$d = b/mu = 12/1.5 \times 1.26 = 6.35 \text{ ft, the depth of uniform flow.}$$

Example 4. To find the critical value for S_o, compute

$$u = b/md = 12/1.5 \times 4.28 = 1.87$$

On Fig. 2, lay a line through $M = 1.20$ and $u = 1.87$ to obtain $1/v = 2.08$. Then compute

$$S_o = (m^{2.5}/vb^4)^{4/3}\,(nQ)^2 = (1.5^{2.5} \times 2.08/12^4)^{4/3}\,(0.02 \times 800)^2 = 0.00461, \text{ the critical slope}$$

For the type of problem illustrated by Example 4, it might prove just as efficient to solve directly from the basic equation. For the other three examples, however, no direct solution is possible.

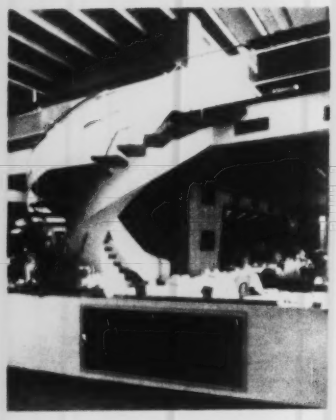
THE READERS WRITE

Helicoidal Staircase Has Cantilevered Treads

To the Editor: Helicoidal staircases similar to that described by Prof. A. C. Scordelis, J. M. ASCE, in his letter in the November 1951 issue (p. 30) have been constructed in a number of places using conventional reinforced concrete. The interest of the original article by Prof. G. Magnel (September 1951, p. 25) lay in the fact that it described the first example of such a staircase of prestressed concrete.

The accompanying photograph shows a helicoidal staircase which connects two levels in the restaurant of the recently completed Royal Festival Hall, London. The main structural member is a reinforced concrete helix, 15 × 18 in. in cross section. The treads, which were precast in terazzo, are cantilevered beyond the outside of the helix as shown.

G. M. I. WILLIAMS, A. M. ASCE
Scott and Wilson, Civil Engineers
London, England



Reinforced concrete helix carries cantilevered treads of precast terazzo in recently completed staircase in restaurant of Royal Festival Hall, London, England. Building was planned by Architects' Department of London County Council. Messrs. Scott and Wilson were the consulting and structural engineers. Photo is through courtesy of contractors, Messrs. Holland & Hannen and Cubitts, Ltd., London.

Cincinnati Section Supports President's Objectives

Dear Mr. Proctor: The Cincinnati Section of ASCE, by action taken at its January meeting, went on record as being heartily in accord with the philosophy and principles expressed in your inaugural address. Many members of the Cincinnati Local Section read your address in the November issue of CIVIL ENGINEERING (p. 47) and were so impressed by your statement of objectives that time was set aside at the Section's January meeting for a full reading of it.

The Cincinnati Section stands ready to follow through on any program that you suggest which will bring about the realization of the desired objectives. Steps are being taken to bring your address to the attention of all engineers in this area through the Cincinnati Technical Council's publication, *Engineer and Scientist*.

E. S. BIRKENWALD, *President*
Cincinnati Section, ASCE
Cincinnati, Ohio

Responsibility for Future of Profession Is Ours Alone

To the Editor: I would like to offer a thought in reply to the letter Mr. Nussbaum so kindly contributed to the December 1951 issue (page 50). In particular I would disagree with the last paragraph of his letter.

"Until engineering is recognized by the American public as a profession and I believe that this is not now the case, engineers (certainly those in government service) cannot hope to be looked upon, or recompensed as, among the most important workers in our society."

It is my thought that engineers are on a wild goose chase when they spend any money to buy so-called "public recognition." Engineers should not look outside the profession for any help for the profession. It may well be that "the fault, dear Brutus, is not in our stars, but in ourselves."

All the rights, benefits and responsibilities which engineers are so desirous of having are merely functions of a most independent variable. This variable may be captioned and labeled "conduct of the engineer." This is not a mathematical term but I trust it conveys my thought.

Looked at in this light the advancement of the profession is a matter for the individual, and the less we expect from the government or any other power, the sooner we will turn to, and face this job which we must do by ourselves and for ourselves.

R. B. MACFARLANE, A. M. ASCE
Macfarlane and Sadler
Consulting Engineers
Richmond, Va.

Realism Applied to Promotion by Examination

To the Editor: Mr. Harrison, in his letter in the November issue (p. 55), has put his finger on what is probably a greater peril to Civil Service than the widely advertised and widely deplored evil of patronage. As to promotion on the basis of examination, he writes:

'Evidently a good knowledge of the particular field is important, but many other things often are vastly more important, such as personality, the ability to make friends and influence people, judgment and integrity. And so far at least, no generally accepted method of evaluating these qualifications has ever been developed. Moreover, until it is, the selection of men for the higher professional positions on the basis of the grades they attain in an examination would be no more accurate than selecting them on the basis of the measurements of their hat bands or the length of their arms.'

Here, by your leave, is realism applied to the problem of selecting men for responsible engineering positions. A written examination permits a man to show his acquaintance with practice, but makes no pretense of evaluating personality, and note this, integrity. Surely, his eligibility depends primarily on these fundamentals, neither of which is to be acquired even more than on technical efficiency, which may well improve with practice. How many successful men at supervisory or executive levels rely for technical detail on subordinates, entirely capable in that field though quite unequal to administration!

A. S. MACGREGOR, M. ASCE
Hornell, N.Y.

Formula Modified to Fit AREA and AASHO Specifications

To the Editor: In the article "Design Method for Eccentrically Loaded Steel Columns Fits Any Code" (December 1951, p. 54), Messrs. Willig and Cunningham have presented a simple and useful procedure for the design of such members.

However, it should be pointed out that the design formula given does not fit codes in which the column formulas take into account the lateral deflection due to the eccentric load. The AREA and AASHO are examples of two commonly used specifications in which the authors' formula would not apply for this reason. Some building codes are also in this category.

The derivation of the design formula (Eq. 7) can be simplified considerably by starting with the AISC design criteria for combined bending and axial stress:

$$\frac{f_a}{F_a} + \left(\frac{f_b}{F_b}\right)_{xx} + \left(\frac{f_b}{F_b}\right)_{yy} = 1$$

and substituting $f_a = \frac{P_c}{A}$ and $f_b = \frac{M}{S} = \frac{MB}{A}$ (in which B is the "bending factor") to obtain:

$$\frac{P_c}{AF_a} + \left(\frac{MB}{AF_b}\right)_{xx} + \left(\frac{MB}{AF_b}\right)_{yy} = 1 \text{ or,}$$

$$\text{Required } A = \frac{P_c}{F_a} + \left(\frac{MB}{F_b}\right)_{xx} + \left(\frac{MB}{F_b}\right)_{yy}$$

The latter equation is identical with the authors' Eq. 7 except for slightly different notation. This derivation emphasizes the fact that the authors' formula applies only when the design criteria is the interaction formula used by the AISC Specifications.

When lateral deflection of the column is considered, as in the AREA and AASHO formulas, the above equation must be modified. To take a specific example, when the column is subjected to equal moments at the two ends, the equation becomes:

$$\text{Required } A = \frac{P_c}{F_a'} + \left[\left(\frac{MB}{F_b'}\right) \sec \frac{l}{2r}\sqrt{\frac{nP_c}{E.A}}\right]_{xx} + \left[\left(\frac{MB}{F_b'} + \frac{0.25\,P_c}{F_b'}\right) \sec \frac{l}{2r}\sqrt{\frac{nP_c}{E.A}}\right]_{yy}$$

in which n is the factor of safety. It should be noted that the stress F_b' is not the same as the allowable bending stress F_b which is used in Eq. 7. According to these two specifications the values of F_b' and F_b are 18.75 and 18.00 kips per sq in. respectively.

Even with this modification, however, the general design procedure presented by the authors is an efficient method by which a column section can be selected for a given eccentric load.

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Asst. Prof. of Structural Engineering, MIT
Cambridge, Mass.

Steel Column Formula Related to AISC Specifications

To the Editor: Professors Willig and Cunningham have presented in the December issue (p. 53) a design method for eccentrically loaded steel columns. At first inspection it might appear that their method was open to question because of two assumptions, presented without proof, in the derivation of their Eqs. 6 and 7. By testing with a problem, however, the design equations are found to give completely satisfactory results. The reason is that these equations give exactly the same criteria as the more familiar and more simply stated AISC Specification 66(a). Indeed, the equations may be derived directly from this specification in a single operation and without any qualifying assumptions. Thus

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1. \qquad 66(a)$$

Changing this into the symbols used in the article, 66(a) becomes

$$\frac{P_c}{S_c}\frac{A}{} + \frac{(M_x \cdot S_x) + (M_y \cdot S_y)}{S_{max}} \leq 1 \qquad 66(a)'$$

Multiplying through by the area A, and recognizing the quantities A/S_x and A/S_y as the more familiar B_x and B_y tabulated in the AISC manual, gives Professors Willig and Cunningham's equation

$$\frac{P_c}{S_c} + \frac{(M_x B_x) + (M_y B_y)}{S_{max}} \leq A \qquad (7)$$

or

$$\frac{P_c(S_{max} \cdot S_c)}{S_{max}} + (M_x B_x) + (M_y B_y) \leq A \qquad (7)$$

As the proposed design method gives exactly the same criteria for combined stresses in columns as the AISC code, it provides no additional resistance against flange buckling or torsional failure over a section selected directly by the code; hence there is no justification for ignoring the Ld/bt ratio of the section. Failure to reduce the allowable bending stresses when this ratio exceeds 600 will result in a section which is inadequate when appraised by the AISC code.

Many design codes have provisions for combined stresses in columns which are identical in effect with AISC Specification 66(a), though the allowable axial and bending stresses may or may not be the same. When used with such a code the proposed design method will give correct results, otherwise not.

A method for design of eccentrically loaded steel columns very similar to that proposed in the article may be devised by slightly modifying the procedure illustrated in the AISC manual. The one change required is that, in converting the bending moment into an equivalent axial load, the quantity should be reduced by the ratio of the allowable axial stress to bending stress, F_a/F_b. When applied to the example illustrated both in the AISC manual and the article under discussion, the method would be as follows.

Problem: Select a 14WF column to carry a concentric load of 300 kips and an eccentric load of 50 kips applied 18 in. from the major axis. The unbraced length of the column is 12 ft.

Solution: Estimate that one of the sections in the 14 × 14⅝ WF group will satisfy the group. The average radius of gyration of the group is 3.73 in., L/r is 38.7 in., and the allowable axial stress F_a is 16.28 kips per sq in. For the lightest section of the group, Ld/bt is 202; hence the allowable bending stress F_b is 20.00 kips per sq in. The average bending factor B_x for the group is 1.85.

Bending moment
= $M = 50 \times 18$
= 900 in.-kips

Equivalent direct load
= $M \times B_x \times F_a/F_b$
= $900 \times 1.85 \times 16.28/20.00$
= 136 kips

Design column load
= 300 + 50 + 136
= 486 kips

Referring to the tabulated values, the smallest column in the group which will carry this load is the 14WF103, rated at 493 kips for a 12 ft length. (Note that 486/493 equals 0.986, as shown in the manual.) A check of the values of r and B_x for the section selected indicates that no further revision is needed.

As all three methods give identical results, the designer may choose the one he finds most convenient.

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SOCIETY NEWS

New Orleans Sets Stage for ASCE Convention

A convention program outstanding not only for the extent of technical interests served, but also for its series of social events against a background of traditional southern hospitality, has been planned by the New Orleans committee in charge of the forthcoming (March 5-7) ASCE Convention. A wide range of technical subjects will be discussed during seventeen sessions sponsored by the Technical Divisions. Recent engineering developments in the New Orleans area will share the spotlight with papers describing significant design and construction projects all over the country. Special study will be given traffic improvement and control in a cooperative session of the City Planning Division and the Institute of Traffic Engineers.

Two special technical features are scheduled for the New Orleans Convention. By special arrangement with the Civil Defense Administration, a group of speakers will discuss engineering responsibilities of the Civil Defense Program. Another session will feature motion pictures of and a talk on the atomic bomb tests at Eniwetok, disclosing features of special concern to civil engineers. These will be presented by D. Lee Narver, Los Angeles consultant whose firm has been prominent in the development of the Eniwetok Proving Ground for the Atomic Energy Commission. A detailed program of convention events was published in the January issue.

Inspection Trips Planned

Supplementing the technical sessions, inspection tours will be made to new engineering projects under way in the New Orleans area. These include new sanitary and power projects and a $50,000,000 civic improvement program centering about construction of a new union passenger terminal and the elimination of grade crossings. A visit will also be made to Pumping Station No. 7, the largest in the world. A yachting trip in the harbor will afford an opportunity to view the extensive waterfront installations that make New Orleans one of the busiest ports in the United States.

Engineers will also be interested in the highly modern business and industrial areas of the city, the Lake Pontchartrain resort area, the Mississippi River Bridge, the Moisant International Airport, Bonnet Carré Spillway, and two unique new institutions established to promote better relationships with other nations—International House and an International Trade Mart.

In dramatic contrast to these highly modern developments is the old city of narrow streets, patios, iron-trellised balconies, and Creole architecture known the world over for its picturesque atmosphere. Dating back to 1718, New Orleans has many historical associations that make it a sightseer's paradise.

Full Social Program

The social events of the convention week include an evening on a Mississippi River Steamboat, a formal dinner dance, teas and luncheons. Those with time for sports and other recreational activities will be offered club privileges. In short, everything has been done by a large Louisiana Section committee, working under the chairmanship of David W. Godat, to make the New Orleans Convention an occasion to be remembered by both the engineers and their families.

For those who have yet to make their travel arrangements, requests for hotel reservations should be sent to Mr. C. Glennon Melville, 7300 West End Blvd., New Orleans, La.

Ocean gateway to the vast mid-continent area of the country and second port in the United States in value of foreign commerce, New Orleans has more than eleven miles of wharves equipped with highly modern mechanical devices. Harbor trip will give visiting engineers an opportunity to view extensive waterfront installations.

Pacific Northwest Conference to Meet in Richland, Wash.

Preliminary plans for the Pacific Northwest Conference of the Society, to be held in Richland, Wash., May 15-17, include interesting technical sessions of papers and discussions, a business meeting, and inspection trips. As host organization to the Conference, the Columbia Section will entertain some 300 engineers from the states of Oregon, Washington, Idaho, and Montana. A separate program is being arranged for the ladies, who are urged to accompany their husbands.

Centennial Convocation Symposium Arranged

The Centennial of Engineering celebration for 1952 appropriately observes the one hundredth anniversary of the founding of the first national society of civilian engineers in the United States—the American Society of Civil Engineers. The observance honors engineers in every branch of the profession because at the inception of ASCE in 1852 civil engineering embraced the entire profession with the exception of military engineering.

More important, the celebration presents an opportunity to tell the people of the country the powerful story of our American heritage—not to evoke commendation or praise—but rather to create an understanding of the factors that have made our nation great. The engineering profession is in a particularly favorable position to depict America's development and its future potentialities. More than forty locally sponsored events already scheduled will lead up to the Chicago Convocation, September 3-13.

Chicago has been chosen for the major events of the Centennial program because of its central location and because it can readily be reached by any one of 22 railroads and 11 airlines. In addition, Chicago has super convention facilities in its 1,385 hotels, with capacity for 225,000 guests. It also has the completely unique Museum of Science and Industry, which will be the center of many of the Centennial program events. Dynamic, push-button exhibits for which the museum is famous all over the world, should give a sound idea of the basic principles behind the spectacular rise in American standards of living during the past century.

General Symposium Sessions Scheduled

The Convocation will bring together the world's outstanding engineers. Daily general symposium sessions, twelve in number, will emphasize for the public benefit the highly significant part played by engineering in developing the United States to its position of world leadership. Each symposium program will include a brief historical review of the subject, a discussion of its present status, and an attempt to lift the curtain of the future. More than 100 speakers, engineers and laymen, will present the story of the social, economic, and political effects of the accomplishment of engineers operating in a free enterprise system—the results of a century of engineered progress.

Under the chairmanship of Harry S. Rogers, M. ASCE, president of the Polytechnic Institute of Brooklyn, a symposium on professional societies and their role will be presented on Wednesday, September 3, at the 5th Street Theater, which is adjacent to the Conrad Hilton Hotel, headquarters for the ASCE Technical Division meetings. On Thursday, September 4, at the 5th Street Theater, Dean Andrew A. Potter, of Purdue University, will lead a symposium dedicated to the education and training of engineers. A symposium on tools? with special emphasis on the machine tool industry, will be held at the 5th Street Theater on Friday, September 5, under the chairmanship of Dean Kenneth H. Condit, of Princeton University. Concurrently, at the Palmer House, there will be a symposium on food: its production, processing, transportation, and marketing. The role of irrigation, a particular problem for civil engineers in arid regions, will be brought into focus as a basic factor in improving human welfare.

On Monday, September 8, three symposiums will run concurrently. At the Conrad Hilton, Charles F. Kettering, Hon. M. ASCE, will direct a symposium on land, sea, and air transportation. Structures relating to highways, railroads, airports, and docks will be covered in the transportation symposium. In a symposium on structures and construction, to be presented at the 5th Street Theater under the chairmanship of Waldo Bowman, M. ASCE, advances in design, adaptation of new materials, and development of construction methods will be included. The third symposium on the mineral industries will take place at the Sherman Hotel under the chairmanship of Clyde E. Williams, director of the Battelle Memorial Institute, Columbus, Ohio.

For Tuesday, September 9, a symposium on the chemical industries is scheduled, together with continuing sessions of the symposiums on transportation and the mineral industries begun the day before. Headquarters will be the 5th Street Theater.

Wednesday, September 10, has been set aside as Centennial Day. Current plans envisage a general luncheon meeting at the Conrad Hilton Hotel, followed by the conferring of such annual awards as the John Fritz Medal and the Hoover Medal and special Centennial medals. The principal Centennial Banquet is scheduled for Wednesday evening. Arrangements are being made to seat and serve some 5,000 people under one roof. The principal speaker will be Charles F. Kettering.

The presentation of symposiums will continue on Thursday and Friday, September 11 and 12. At the 5th Street Theater, there will be a symposium on communication. In it the effect of printing, telephone, telegraph, radio, radar, motion pictures, and television on our lives will be emphasized. Sessions will begin on Thursday and continue through Friday. Under the chairmanship of Eugene Ayers, of the Gulf Research and Development Co., a symposium on various forms of energy and their influence on the development of the United States will be presented on Thursday and Friday by a cast of experts in the generation, transmission, and utilization of steam, internal combustion, hydroelectric, and atomic power. The place will be the Conrad Hilton Hotel. At the La Salle Hotel, on Thursday, Dr. Thomas A. Parran, head of the School of Public Health at the University of Pittsburgh, will lead a symposium on health and the part that engineers in cooperation with the medical profession have played in creating an environment conducive to public health, and to the development of prosthetic and sensory aids and of mechanical devices for successful surgery. A symposium on urbanization will be held at the La Salle Hotel on Friday. Papers in this symposium will deal with underlying problems of urban development, specifically the physical layout of cities, traffic, water supply, sewerage, and public utilities.

Centennial Convocation Committee

The Centennial Convocation Committee is headed by Henry T. Heald, M. ASCE, chancellor of New York University. Other members of the committee are E. R. Weidlein, president of the Mellon Institute of Industrial Research; Frederick V. Geier, president of the Cincinnati Milling Machine Co.; A. P. Greensfelder, Hon. M. ASCE, chairman of the Frain Common Contracting Co., St. Louis; and E. G. Bailey, vice president, Babcock and Wilcox Co., of New York. E. L. Chandler, Assistant Secretary of ASCE, is secretary of the committee and Convocation manager.

In addition to the general symposium sessions, sponsored by this Centennial committee, 50 national and international organizations will hold independent and concurrent conventions of their own during the Convocation period. Thirteen Technical Divisions of ASCE plan stimulating sessions (January 1952 issue, page 100). Although some Technical Division sessions must of necessity run concurrently with the Centennial symposium sessions, they are being scheduled to give members maximum opportunity to attend a maximum number of meetings of interest to them.

ASCE Executive Committee Meets in Detroit

Members of ASCE Executive Committee, in session in Detroit during recent annual meeting of Michigan Section (January issue, page 110), gave careful consideration to role of ASCE in Centennial of Engineering celebration. Committee also approved program for Society's Annual Business Meeting, to be held in Engineering Societies Building, New York, October 12-15, during which Board of Direction will meet and new officers will be installed. No technical meetings are contemplated in New York in 1952. Seated are Fred C. Scobey, Vice-President, Zone IV; President Carlton S. Proctor; Daniel V. Terrell, Vice-President, Zone III; and Gordon H. Butler, Director, District 7. Standing are Clyde Palmer, president of Michigan Section; ASCE Past-President Ernest E. Howard; William R. Glidden, Vice-President, Zone II; Executive Secretary William N. Carey; Edwin Finney, president-elect, Michigan Section; and Dudley Newton, secretary-treasurer, Michigan Section.

Current Litigation in Tennessee Affects Professional Rights of Engineers and Architects

A. T. GRANGER, M. ASCE
Professor of Civil Engineering, University of Tennessee, Knoxville, Tenn.

There is now before a Chancery Court in Nashville, Tenn., a suit that is of the utmost importance to every engineer in the state and, less directly, of great importance to all engineers throughout the United States.

The Tennessee registration law for architects and engineers, passed in 1921, protects the titles "Architect" and "Engineer," but it does not define either nor does it specifically draw any distinction between the type of work which may be done by either. It was patterned after the American Engineering Council model law with the intention of avoiding jurisdictional disputes and permitting either a registered architect or registered engineer to do whatever he is competent to do. The legal justification of the law, as stated therein, is to protect public health, safety, and property.

For many years architects and engineers functioned harmoniously under this law, administered by the State Board of Architectural and Engineering Examiners, consisting of three engineers and three architects. Within the past few years, however, some architects have manifested a growing disposition to try to use the law to circumscribe and restrict the activities of certain registered engineers doing building work. The procedure used has generally been to complain to the Board that the engineer in question is practicing architecture without a license, and to request the Board to restrain or limit his activities.

Attempts to settle the issue amicably have been made. It was thought that a satisfactory agreement had been reached in February 1950 by a joint advisory group of five engineers and five architects. The agreement was subsequently ratified by both the Tennessee chapter of the American Institute of Architects and the Tennessee Society of Professional Engineers. However, attempts to apply the agreement to specific cases failed because architectural representatives would not concede that registered engineers competent in such work had a legal right to design buildings.

One of the engineers most directly concerned finally concluded that his best course was to seek a court declaration of his legal rights and for this purpose brought suit in June 1951. The Tennessee chapter of the American Institute of Architects has filed an intervening petition in this suit on the ground that its interests are affected; the Tennessee Society of Professional Engineers has also filed an intervening petition on similar grounds. The engineers are prepared to fight the case through the State Supreme Court if necessary.

The following is a verbatim quotation from the intervening petition of the Tennessee Chapter of AIA, filed in June 1951:

"That at the hearing the complainant be enjoined from the practice of architecture and specifically that he be enjoined from designing, planning, constructing, or supervising the construction of any building, whether residential, commercial, or industrial, or for public use, whether on land owned by himself or not, and that if proper, *pendente lite*, such an injunction issue."

The Court is also asked to declare that acts such as the foregoing "constitute the practice of architecture and that one engaged in such practices is required to be a licensed architect under the provisions of the Code of Tennessee."

The nature of these contentions is such that every engineer, contractor, and taxpayer may well consider seriously what the effect would be if they were sustained by the courts.

The following verbatim quotations from the intervening petition of the Tennessee Society of Professional Engineers state the position taken by the engineers:

"With respect to the state licensing law your petitioner avers that the following interpretation of the state law is the true and correct interpretation:

1. That the state law was passed for the purpose of safeguarding life, health and property, and to promote the public welfare.

2. That, in order to effect the purpose of the law, all structures affecting public health, safety or welfare must be designed by a licensed engineer or a licensed architect or both and that the licensed designer is responsible to the public for the safety of the design.

3. That the structural parts, electrical, plumbing, heating and power equipment, the design of which is an applied science, are the parts that affect the safeguarding of life, health and property, and that the administrative works of properly following the principal's instructions, the building laws, letting of contracts, certifying payments and the like, affect the promotion of the public welfare.

4. That a licensee has the legal right to practice to the limit of his competency, and that competency shall be determined on the basis of safeguarding life, health and property and the promotion of the public welfare.

5. That the procedure provided for in Section 10 of the state licensing law is to be followed by those who claim that a licensee has practiced incompetently."

Resolutions endorsing the stand of the TSPE have been passed by Sub Sections of the Tennessee Valley Section and by the Mid South Section of ASCE. This is not the first state in which this battle has been fought, and the TSPE is confident that it will secure a satisfactory solution.

Engineering Foundation Sponsors New Volume

An authoritative volume on the behavior of fabricated steel structures under compression has just been published by the McGraw-Hill Book Co. Entitled *Buckling Strength of Metal Structures*, the volume is one of a series of Engineering Societies Monographs sponsored by the Engineering Foundation. The author, the late Friedrich Bleich, M. ASCE, worked in close cooperation with the Navy's David Taylor Model Basin (Bureau of Ships), the staff of Frankland & Lienhard, New York consultants, and the Column Research Council in developing this reference volume of tables and simplified approximate formulas and methods for design engineers. He has extended the theories of elastic buckling into the inelastic range, covering latest methods for analyzing the stability of high strength alloys used in a wide range of structures and in ships' hulls.

Collaborating on the 508 page illustrated work was Condr. Lyle B. Ramsey, of the U. S. Navy, and the editor was Hans H. Bleich, M. ASCE, associate professor of civil engineering at Columbia University. The volume is priced at $10.

New Postage Stamp to Commemorate Centennial

Among seven new commemorative postage stamps approved by Postmaster General Jesse M. Donaldson for issue in 1952 will be a stamp marking the centennial of the American Society of Civil Engineers. Design of the proposed stamp is under study by a committee of engineers and artists.

Salary Data Found Effective in Baltimore

The usefulness of survey data such as those recently collected by the ASCE Salary Committee has been demonstrated in Baltimore, Md. Current salaries for engineers in that city follow almost exactly the scales recommended by the Society in 1946, to which a 5 percent cost of living bonus was added for the year 1951.

Since publication of the more recent ASCE survey data, the city's Board of Estimates, upon the recommendation of a Salary Revision Committee, has adopted a new scale, effective January 1, 1952, that follows very closely the median ranges reported for the 50 public organizations surveyed during the early part of 1951. The complete ranges, covering all grades of engineers, from the new graduate, with no experience whatever, to the top engineering and administrative jobs, are given in the accompanying tabulation.

Title	Equivalent Grades: ASCE Grade	Federal Service Grade	Salary Range Effective Jan. 1, 1952
Junior Engr.	I	5	$ 3,500- 4,100
Senior Engr.	II	7	4,200- 4,900
Junior Assoc. Engr.	III	9	4,600- 5,400
Senior Assoc. Engr.	IV	11	5,500- 6,500
Prin. Assoc. Engr.	V	12	6,500- 7,500
Deputy Chf. of Bureau	VI	13	7,500- 8,500
Chf. of Bureau	VII†	14†	8,500-10,000*
Deputy Director of Public Works	VIII	15	12,500†
Director of Public Works	IX	16	15,500†

* Appointive office with fixed salary rate, different for different Bureaus.
† Appointive office with fixed salary rate.

New officers of Georgia Section are photographed at recent all-day annual meeting in Atlanta attended by ASCE Director James A. Higgs and retiring Director Edmund Friedman. In front row in usual order are Mr. Friedman, Moses E. Cox, retiring president; Warren S. Mann, incoming president; and Mr. Higgs. In back row (same order) are C. M. Mower, Jr., retiring secretary-treasurer; B. J. Bell, incoming secretary-treasurer; Josef Patchen, vice-president elect; M. L. Shadburn, vice-president; and H. G. Carter, retiring vice-president. Technical sessions featured papers by prominent Georgia engineers and Georgia Institute of Technology students.

1951 Index Available

Members wishing to incorporate the index to Volume 21 of "Civil Engineering" in their 1951 bound volumes may obtain copies without charge on request to Society Headquarters. A postal card request will be adequate.

Single copies of the index are sent to all subscribing libraries. Extra copies are available on request.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Legislation

With Congress again in session, we are reminded that several pieces of unfinished business of interest to the profession are already before it and that some new bills will be introduced. Bills relating to the reorganization of the government, including one proposing a Board of Impartial Analysis for engineering projects, are under study in committees. Stream pollution and air pollution problems are also dealt with in bills carried over from the first session. The St. Lawrence Waterway proposal now that Canada has voted to undertake the project alone if necessary, may possibly again become a live issue. The present economic controls legislation expires June 30; hence legislation providing for a continuance of such restrictions must be considered. National water policies are under study in several committees which will give careful consideration to the Engineers Joint Council report on the subject.

It will be difficult to enact any legislation not related to defense during the remaining months of the 82nd Congress.

Executive Departments

Much action can be expected from the executive departments and agencies. A recent departmental decision of more than usual interest was the approval by the Post Office Department of the issuance of a special commemorative postage stamp to mark the centennial of ASCE.

The Society's Surveying and Mapping Division as well as the Committee on Mapping and Surveying of the District of Columbia Section is engaged in a discussion with the Civil Service Commission of the engineering requirements for surveying and mapping positions, following the issuance of a new "cartographic" classification by the Commission.

The Salary Stabilization Board is planning to open 14 field offices. The offices will be in Boston, New York, Philadelphia, Richmond, Atlanta, Cleveland, Detroit, Chicago, Minneapolis, Kansas City, Dallas, Denver, San Francisco, and Seattle. Pending the opening of these offices, information on salary stabilization matters may be obtained through the 80 field offices of the Wage and Hour Division of the Department of Labor.

Director Harriman of the new Mutual Security Agency has announced a new organizational structure with the designation of a Deputy and an Associate Deputy Director, a U. S. Special Representative in Europe, a Director of the European Office, and several Assistant Directors. Greater emphasis will be placed on the Far East than heretofore, emphasizing help to the newly independent countries to expand their economies to provide for the basic human needs of their people.

DPA and NPA Controls

Materials restrictions continue to be one of the problems of greatest concern. With an expected 1952 production of military goods double the 1951 output, shortages of critical materials, particularly copper, are leading to further restrictions on non-defense building. NPA has announced that virtually no new commercial construction will be permitted to start during the second quarter. New housing starts will be cut drastically below the first quarter, about 150,000 for the second quarter as compared to 210,000 for the first, on the basis of the materials allocations.

The structural steel screening committee mentioned last month has succeeded in improving the timing of structural steel requests but not enough to equalize demand and supply. Structural steel will be scarce during much of the year. Plate demands, especially for pipe lines, will be greater than supply even beyond 1952. Sheets and some other products should become readily available soon. With a national capacity of 120 million ingot tons after the completion of the current steel expansion program, steel should be readily available next year, except in certain special situations.

According to Direction 4 to CMP Regulation 6, Jan. 17, 1952), water well drilling contractors are to apply by quarters in a single request for materials for all the wells they are to construct which use less than six tons of carbon steel or 200 lb of copper each, modifying the existing application procedure.

On February 12 a major meeting of representatives selected from the trade and professional organizations in the construction industry will convene to discuss materials allocations and other construction controls. This Construction Industry Advisory Council will make some important recommendations to the government concerning these controls.

Important Supreme Court Decision

The decision of the U. S. Supreme Court in the case of United States vs. Wunderlich, holding that the ruling of a government contracting officer and his department head in a dispute on a contract is final on any question of fact unless fraud is alleged and proved, has important implications both for contractors and for engineers.

The Court of Claims had awarded $172,000 to the contractor for extras on the grounds that the finding of the department head in denying his claim was "arbitrary," "capricious" and "grossly erroneous." The contract clause provided that all disputes involving questions of fact should be decided by the contracting officer with right of appeal to the head of the department "whose decision shall be final and conclusive upon the parties thereto."

The Supreme Court has indicated that when the contractor agreed to accept such a decision as final he took the risk of its being erroneous and arbitrary, and that only fraud, alleged and proved, would suffice to have such a decision set aside. The Court frankly stated that if a less limited standard was desired, Congress should so provide.

Three Justices disagreed in equally positive and vigorous language. Justice Douglas in his dissent said, "But the rule we announce has wide application and a devastating effect. It makes a tyrant out of every contracting officer. . . . He has the power of life and death over a private business even though his decision is grossly erroneous."

This decision may also serve to prevent review by other government departments which normally review all proceedings and accounts relating to a contract. The Associated General Contractors is suggesting corrective legislation.

Washington, D.C.
January 22, 1952

ASCE MEMBERSHIP AS OF JANUARY 9, 1952

Members	7,995
Associate Members	10,187
Junior Members	15,700
Affiliates	66
Honorary Members	37
Fellows	1
Total	35,986
(January 9, 1951	31,372)

Engineering Curricula Accredited by ECPD

Addition of three civil engineering curricula to the accredited list of colleges and universities accredited by Engineers Council for Professional Development was announced by ECPD at its recent meeting in Boston. These curricula are at the University of Dayton, Ohio University, and the University of Hawaii.

ASCE has Student Chapters at the University of Dayton and the University of Hawaii.

Task Committee Will Study ASCE Divisions

A study of ASCE technical organization was ordered by the Executive Committee of the Society at its December meeting. The task committee will be headed by Prof. Jewell M. Garrelts, secretary of the Structural Division. Others appointed to it are Frank A. Marston, ASCE Director for District 2; Philip C. Rutledge, past-chairman of the Soil Mechanics and Foundations Division; George R. Schneider, past-chairman of the Hydraulics Division; and ASCE Vice President Daniel V. Terrell, chairman of the Committee on Division Activities.

The Committee will study the Society's technical organization in its relationship to such engineering functions as economics, management, construction, and research. A report with recommendations will be presented later.

California Conference of Local Sections Planned

The four California Sections of ASCE have scheduled their annual conference for May 2 and 3 in San Diego, with headquarters at the U.S. Grant Hotel. Preliminary registration will start on Thursday afternoon, May 1, and there will also be a meeting of Section officers with the Executive Committee of the ASCE Board of Direction that afternoon. The evening will be devoted to an informal get-together and entertainment.

Tentative arrangements for the conference itself call for a morning technical session and luncheon with Student Chapter delegates and the annual student paper contest. Runners up in the student contest will present their papers at a banquet to be held Friday evening, May 2. It is expected that ASCE President Carlton Proctor will be able to attend the banquet and speak, and the evening will close with dancing. Saturday will be given over to a student forum, a joint meeting of engineer and students for briefing on the afternoon inspection trip. A choice of four trips will be offered Saturday afternoon, the details to be worked out later.

Kansas City Section honors its new ASCE life members at recent dinner meeting. Standing left to right, are Samuel J. Callahan; Life Member Robert B. Houston; Clifford Kimberly; Life Member Jerome A. Moss; Theodore J. Cambern; Life Member David M. Dodds; John Q. A. Greene, retiring president of Kansas City Section; Reed McKinley, first vice-president; Richard R. Tipton, secretary-treasurer; President-Elect W. L. Patterson; Clare Van Orman, second vice-president; and Fred K. Beatty, retiring junior director of Section. Other new Section recipients of life membership unable to attend meeting are Henry Stanley Allen and Thomas Paul Humphrey. Charles C. Campbell was elected junior director to succeed Mr. Beatty.

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Akron	...	11	Dinner meeting devoted to awarding life membership certificates to Wm. C. Giffels and E. D. Barstow.
Central Illinois	December 11	63	Joint dinner meeting with Student Chapter. Dean H. H. Jordan reported on the Engineering Manpower Commission Convocation. An illustrated talk on bridges in the Santa Fe Railroad system was presented by C. H. Sandberg, assistant bridge engineer of the Atchison, Topeka, and Santa Fe Railroad. New officers are W. Leighton Collins, president; Carl N. Wahl, first vice-president; William A. Oliver, second vice-president; and Clyde E. Kesler, secretary-treasurer.
Cincinnati	January 2	47	Edward Farmer, engineer with Black and Veatch, Consultants, spoke on recommended improvements for the Cincinnati water supply system.
Cleveland	January 11	150	Annual meeting on ASCE affairs addressed by Dean D. V. Terrell, Vice-President, Zone III.
Colorado	December 10	102	Ladies Night. Award of life membership certificates followed by showing of a sound movie.
Columbia	...	...	Newly elected officers include Edward E. Gerrick, president; Melvin B. Nelson, first vice-president; Louis E. Rydell,

Coming Local Section Events

Central Ohio Dinner meeting on February 21, 1952.

Cleveland Meeting at the Public Auditorium, on February 21, at 8 p.m.

Colorado Meeting at the Democratic Club, Denver, on the second Monday of each month, at 6:30 p.m.

Dayton Luncheon meeting at the Engineers Club, on February 18, at 12:15 p.m.

District of Columbia Annual dinner meeting at the Hotel Statler, on February 19, to be addressed by President Carlton S. Proctor.

Georgia Luncheon meetings on the first Friday of each month, at 12:30 p.m.

Los Angeles General meeting at Alexandria Hotel, on February 13, at 6:30 p.m. Discussion on civil and military works program of Corps of Engineers. Junior Forum meeting at Alexandria Hotel, on February 14, at 6 p.m. and weekly Friday luncheons at 12 noon. Sanitary Group meeting at Hotel Clark, on February 27, at 6:30 p.m.

Maryland Dinner meeting at the Engineers Club of Baltimore, on February 13, at 7 p.m., preceded by cocktails at 6 p.m.

Metropolitan Meeting in the Engineering Societies Building, February 20, at 8 p.m. Meetings of Junior Branch in the ASCE Board Room, New York City, on February 13 and 27.

Mexico Dinner meetings at the University Club, the second Tuesday of each month at 8 p.m.

Montana Meeting of the Hungry Horse Branch at the Bureau of Reclamation Conference Hall, on the second Wednesday of each month, at 8 p.m.

Philadelphia Meeting at the Engineers Club, Philadelphia, February 12, at 7:30 p.m., preceded by dinner at 6 p.m.

Providence Meeting at the Providence Engineering Society, on February 14.

Tennessee Valley Chattanooga Sub-Section meeting at Hotel Patten, Chattanooga, on March 11, at 5:30 p.m. Knoxville Sub-Section meeting at S & W Cafeteria, Knoxville, February 13, at 6:30 p.m.

Scheduled ASCE Conventions

NEW ORLEANS CONVENTION
St. Charles Hotel
New Orleans, La., March 5–7
1952

DENVER CONVENTION
Cosmopolitan Hotel
Denver, Colo., June 16–20,
1952

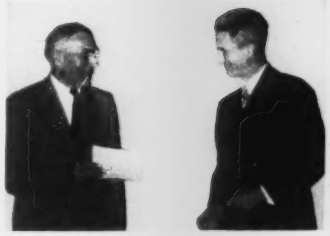
CENTENNIAL CONVOCATION
Conrad Hilton Hotel
Chicago, Ill., September 3–13,
1952

Speakers' table at recent annual meeting of Puerto Rico Section shows (left to right, facing camera) William McFarland, retiring vice-president; Mrs. Ramon Gelabert; Retiring President Gelabert; Mrs. Franklin O. Rose; Vice-President Rose; Mrs. William C. Hill; and Mr. Hill, section president for 1952. Other new Section officers include James R. Cook, vice-president; Jose L. Capacete, secretary-treasurer; and Don U. Deere, assistant secretary-treasurer. Photo courtesy "El Imparcial," San Juan, Puerto Rico.

			second vice-president; and Elmo Sims, secretary-treasurer.
Florida	December 8		Field trip to observe progress on bridges over St. John River, Jacksonville.
Georgia	January 4	86	Dinner meeting. Warren S. Mann, president, presided over business meeting following social hour and dinner.
Indiana	December 13	59	Dinner meeting. Newly elected officers are Kenneth B. Woods, president; Clyde F. Williams, vice-president; Max L. Mitchell, secretary-treasurer; and Thomas F. Driscoll, assistant secretary.
Inter-mountain	December 6	21	Annual business meeting featuring election of officers: Robert L. Sanks, president; Jerald L. Christiansen, first vice-president; and F. Marion Warnick, second vice-president.
Ithaca	January 8	33	Dinner meeting. Award of life membership certificate to Frank Leonard Bolton. Talk by E. P. Swatek, chief design engineer, Dravo Corporation, Pittsburgh, on Lock No. 2, Monongahela River.
Kansas	December 7	55	Panel discussion entitled "Recent Developments of Highway Problems," moderated by George Epps.
Los Angeles	December 12	114	Annual meeting. Installation of new officers, including Roy L. Anderson, president; John Q. Jewett, vice-president; George E. Brandow, vice-president; John Merrell, Jr., treasurer; and L. LeRoy Crandall, secretary. Paul Jeffers spoke on "Policies and Underlying Philosophy of Registration of Civil Engineers in California."
	January 9	265	Speakers Robert J. Kadow of S. B. Barnes & Associates, George E. Brandow of Brandow & Johnston, and M. J. Skinner of Murray Erick Associates, discussed the structural design of the Hotel Statler, Tishman office buildings, and UCLA Medical Center. Life membership certificates were awarded.
Metropolitan Junior	January 9	...	Elmer Leuliette, of Universal Pipe Company discussed "The Rudiments of Concrete Pipe."
Miami	December 6	...	Annual meeting. Newly elected officers are Carl Lindholm, president; Warren D. Brockway, vice-president; Robert W. Hart, secretary; and Herbert D. Morrison, treasurer.

New Mexico	December 7		Annual meeting. Life membership certificates awarded to Neal Hanson and Fred D. Hartford.
Northwestern	January 7	56	James S. Holdhusen, who was unable to attend the Society's Annual Meeting in October, when ASCE prizes were awarded, received the Society's J. C. Stevens award. A talk on glued laminated wood was given by Alan D. Freas, engineer of Forest Products Laboratory, U. S. Department of Agriculture, Madison, Wis. Officers for 1952 are George V. Guerin, president; Miles S. Kersten, first vice-president; Walter V. Buck, second vice-president; and Thomas R. Klingel, secretary-treasurer.
Philadelphia	January 8		Dinner meeting. Charles S. Whitney, of Ammann and Whitney, Consulting Engineers, spoke on "Modern Applications of Concrete Shells and Long Span Arches."
Delaware Sub-Section	December 11		Joint meeting with local section of ASME addressed by Harry S. Spitz, assistant chief engineer, Construction Engineering Bureau, U. S. Steel Co., who spoke on the company's new Fairless plant at Morrisville, Pa.
Pittsburgh	December 13	75	D. L. Sommerville, chief engineer, Central Region, Pennsylvania Railroad, outlined the subject of the program, "Industrial Planning for the Pennsylvania Railroad Freight Terminal," H. J. Larson, of Hunting, Larson & Dunnells, Consulting Engineers, and R. J. Mitchell, vice-president and general superintendent of the Trimble Company, gave solutions to the problem.
	January 8	72	Joint meeting with the Civil Section, E.S.W.P. J. F. Laboon spoke on design problems of the Allegheny County Sanitary Authority.
Providence	December 13	55	Joint meeting with Brown University Student Chapter. Speakers for the evening were Walter J. Shea, chief, Division of Sanitary Engineering, Rhode Island State Department of Health, and Charles G. Hammann, chief engineer, Blackstone Valley Sewer District Commission.
Sacramento	December 4		Luncheon meeting. Life membership certificates were presented to five members.
	December 11	66	Joseph F. Poland, District Geologist of the U.S. Geological Survey spoke on the growth of ground water activities.
		297	Luncheon meeting. Entertainment presented by R. Robinson Rowe.
San Diego	December 15	42	Field trip. Inspection of Southerland Dam, conducted by Paul Beermann, city hydraulic engineer, followed by a picnic lunch.
	December 20	38	Dinner meeting. Newly elected officers are A. K. Fogg, president; R. H. Wilken, first vice-president; R. K. Fogg, second vice-president; G. R. Saunders, secretary; and Quentin Rust, treasurer.
Toledo	December 5	49	Annual meeting. Raymond C. Reese discussed the latest developments in reinforced concrete design. Life membership certificates were awarded. New officers are J. C. Webber, president; R. C. Hansen, first vice-president; R. J. Nopper, second vice-president; and H. W. Grell, Jr., secretary-treasurer.
West Virginia	December 7	37	Dinner meeting. Life membership awards to Cleophus Sweeker, W. O. McCluskey, Jr., John H. Harvell, Harry K. Carpenter and John P. Bonner announced. A talk on railroad engineering was given by Walter P. Young, chief engineer, Norfolk and Western Railroad.

FLORIDA SECTION



G. H. Brunette (right in top photo) receives life membership certificate from Prof. C. D. Williams at annual meeting of Florida Section in Gainesville. In lower view, Prof. G. P. Boomsliter (left) receives certificate from Prof. W. L. Sawyer. Other recipients J. E. Morelock and H. E. Rieringer were unable to attend. New Florida Section officers include James Shivler, president; Nathan Grout, vice-president; and D. A. Firmage, secretary-treasurer. Photos courtesy of Larry Doyle.

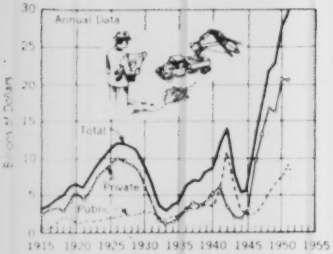
NORTHEASTERN UNIVERSITY STUDENT CHAPTER

Northeastern University Student Chapter honors retiring Contact Member, Miles N. Clair, vice-president of Thompson & Lichtner Co., Inc. Shown here (left to right) are Faculty Adviser Ernest L. Spencer, Co-chairman Arthur S. Lamprey, Mr. Clair, and Co-Chairman Angelo J. Polvere. Mr. Clair received a desk set as a gift from the Chapter.

NEWS BRIEFS . . .

Construction Total for 1951 Placed at Almost $30 Billion

Expenditures for new construction reached almost $30 billion in 1951, according to a joint report of the U. S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the Department of Commerce. Representing a 7 percent rise over the 1950 total of about $28 billion, the 1951 total resulted from increased public outlays for military construction, defense plants, and schools. Despite increased dollar outlays for the year, the physical volume of new construction put in place did not exceed 1950 levels. The additional amount spent was absorbed by higher construction costs.



Dollar value of new construction placed in 1951 is 7 percent above 1950 total of about $28 billion, according to Department of Commerce curves

On a seasonally adjusted basis a gradual reduction in total construction activity took place in the last half of the year from record levels of the preceding 18 months. A decline in homebuilding activity, restrictions on commercial building, and delays in non-defense construction projects (largely attributable to materials shortages) contributed to the downward trend of new construction. Indications are that these factors will continue to have a depressing effect on new construction in 1952, the joint agencies declare.

Total private outlays of $20.8 billion for new construction in 1951 were equal to the 1950 total. Although housing and retail store and recreational construction declined, there was an equivalent increase in expenditures for new industrial plants and utilities, office and warehouse buildings, religious and institutional construction. Expenditures for new industrial construction were nearly double the 1950 volume. Early in the year the rate of private investment in new construction was considerably above 1950 levels, but by December it had dropped to a point 12 percent below a year ago.

Public outlays for new construction in 1951 exceeded $9 billion, an increase of 27 percent over the 1950 total. Expenditures for new military command facilities, totaling more than $1 billion, were nearly six times as great as in 1950. Outlays for atomic energy and defense plants amounted to $880 million, almost four times the 1950 total for such purposes. A new record was set in the volume of school buildings when expenditures rose by 28 percent. Highway construction and reclamation work were off slightly from 1950 levels.

Although delays in obtaining materials, especially for heavy construction projects, began to appear by the middle of 1951, builders continued to start a number of new projects. Consequently, by the fourth quarter, when construction came completely under the Controlled Materials Plan, structural steel and other critical materials were insufficient to provide for all projects already under way, and some were delayed. Despite the fact that the inception rate of new projects has declined in recent months, further delays in some projects not directly connected with defense production appear inevitable. This situation the joint agencies attribute to the rapid dwindling of materials available for non-defense construction.

Final Section of New Jersey Turnpike Opened

The New Jersey Turnpike Authority opened to traffic the final nine mile section of its 118-mile superhighway from Deepwater to Ridgefield Park, N. J., on January 15. Completion of this final link from Newark to the northern terminus near the George Washington Bridge was celebrated with dedication ceremonies at the Passaic and Hackensack River bridges and a final ribbon cutting at Ridgefield Park, N. J.

Speakers included Gov. Alfred E. Driscoll of New Jersey, Paul L. Troast, chairman of the Turnpike Authority, and George F. Smith, vice chairman of the Authority. Mr. Troast noted that more than 1,000,000 cars have already used the Turnpike, producing revenues of $850,000, and that, while 1952 traffic estimates indicated a traffic volume of 23,000 vehicles a day, 43,000 vehicles used the road between Newark and the southern terminus at Deepwater on a recent Sunday.

Mr. Smith stated that the 20-cent toll between Newark and the Lincoln Tunnel interchange is "probably the greatest toll facility value in the country." Even so, he said, the Authority will study toll rates in the light of traffic experience with the aim of reducing tolls where it is possible to do so. The toll for the entire 118 mile length of the Turnpike is $1.75, with tolls on the northern section proportionately much higher.

The $255,000,000 superhighway, which will permit travel through New Jersey in two hours, was planned, designed and constructed in only 30 months despite delays caused by materials shortages. Fourteen papers on design, construction, and financing of the project were published in the January issue.

Huge Equipment Plant Started

With award of a contract to the Consolidated Engineering Company of Baltimore, design and construction of a new multi-million dollar plant to be built by the Caterpillar Tractor Co., in Springettsbury Township (York County), Pa., will get under way, according to an announcement from T. R. Farley, vice president of the company. Whittman, Requardt and Associates, also of Baltimore, will collaborate with the company in developing the design and engineering features of the new plant.

A construction schedule that will permit the start of production in the new plant by the middle of 1953 is planned.

Contract Given for AEC Process Piping at Paducah

A $75,000,000 contract has been awarded the M. W. Kellogg Company, refinery engineers and metal fabricators of New York City, for the field fabrication and erection of the process and auxiliary piping and related equipment in the two major gaseous diffusion units under construction by the Atomic Energy Commission at Paducah, Ky. These processing sections, said to represent the ultimate in complexity, will be designed for both resistance to corrosion and low-temperature operation.

Similar to the K-25 installation at Oak Ridge the Paducah plants will separate the fissionable isotope, U-235, from uranium hexafluoride, a gasified compound including both the normal uranium and its "explosive" isotope. The Oak Ridge installation was engineered by the Kellogg Company, through a specially formed subsidiary, the Kellex Corporation.

Do You Need More Steel?

Persons having difficulty in obtaining steel for building and other projects under today's defense regulations can help themselves get it by finding metal scrap and seeing that it reaches the steel industry. This message came out of a recent National Production Authority conference called in Washington by Charles E. Wilson, director of the Office of Defense Mobilization.

In an open discussion on how to implement the scrap-salvage program, it was emphasized that, with less scrap coming out of normal sources because of the defense program, new sources of supply must be found. As engineers know, the steel industry depends on scrap gathered throughout the country for at least 25 percent of its production. This means that for every ton of scrap recovered four tons of steel can be made. The remaining raw material required for steel production consists largely of pig iron and home scrap, which is generated within the steel mills themselves.

Many industries—seemingly remote from metals—can aid themselves as well as the defense program by uncovering unused machinery, obsolete plant, old trucks and cars, and junk piles. The conference emphasized the importance of recovery of copper, brass, bronze, aluminum, lead and zinc as well as steel scrap.

Commission to Survey Missouri River Basin

An eleven-member commission has been created by President Truman to draft an up-to-date plan for the coordinated development and conservation of the land and water resources of the Missouri River Basin. The body, which will be called the Missouri Basin Survey Commission, was established by an Executive Order that calls for a report on findings and recommendations to be made within a year. It will consist of both private citizens and members of Congress.

Pointing out that the 1951 floods emphasized the need for an up-to-date survey of the basin, President Truman noted that there has been no thorough study of plans for flood control, irrigation, navigation, and hydroelectric power development in the Missouri Basin since Congressional authorization of the Pick Sloan Plan in 1944.

According to the President, the Pick-Sloan Plan and a Department of Agriculture program for development and conservation of land resources, submitted to Congress in 1949, contain "much that is valuable and sound today." However, he added, "there is need now for a thorough re-evaluation of the whole problem." Pending Congressional authorization of the survey, work in the basin will proceed under the Pick Sloan Plan, a joint arrangement that utilizes engineers of both the Corps of Engineers and the Bureau of Reclamation.

The President disclosed that this year he will not renew his request for Congressional approval of a Missouri Valley Authority to supervise development of the area along lines similar to those followed by the Tennessee Valley Authority. The MVA proposal was originated by President Roosevelt in 1944.

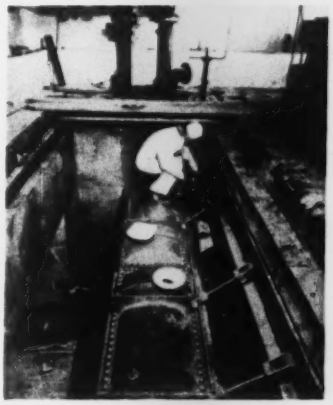
Contracts for Venezula Ore Project Awarded

Award of a general contract to Constructora Bechtel, S.A., for construction of the Orinoco Mining Company's Cerro Bolivar project in Venezuela is announced by the company, a subsidiary of the United States Steel Corporation.

An affiliate of the Bechtel Corporation, Constructora Bechtel, S.A., will supervise, direct and engineer construction of the mine facilities, a 90-mile railroad and highway from Cerro Bolivar to the port, and port and ore-loading facilities, including power plants, housing, water supply and sewer systems. It is expected that some of the facilities will be built by Venezuelan contractors. Construction will start at once with shipment of iron ore scheduled to begin in 1954.

Construction of the standard gauge class A railroad and a highway from Puerto Ordaz on the Orinoco River to the mine will be handled by Morrison-Knudsen de Venezuela, an affiliate of the Morrison-Knudsen Company, Inc. of Boise, Idaho.

Britain Installs First Atomic Heating System

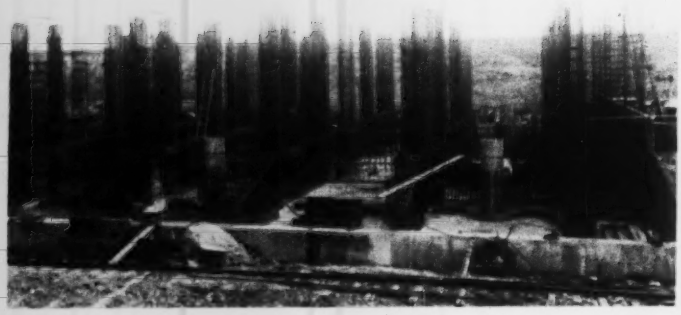


Britain now has world's first atomic heating plant at its atomic research establishment, Harwell, where 80-office building draws its heat from large experimental atomic pile. Project saves some 1,000 tons of coal annually, equivalent to about $5,500. Cost of installation was $42,000. Water is heated by heat-exchanger placed in outlet air duct of pile's air-cooling system and then passed by closed circuit to second heat exchanger that heats water for the radiators and domestic hot-water system. Photo shows early stages in construction work on atomic central heating plant. Wide World Photo.

France Builds Huge Hydroelectric Project

Under construction on Isere River in French Alps at altitude of one mile is $140,000,000 hydroelectric project, which is being built for Electricite de France. Project involves Tignes Dam (shown here), a 500-arch structure, the highest in Europe; two outdoor powerhouses with heads of 760 and 2,460 ft; and connecting tunnels. Construction of project, to be completed in 1952, is by L'Entreprise Industrielle of Paris. American methods and equipment are largely in use. Paul A. Montagne, Jun. M. ASCE, is field engineer on dam, designed by Andre Coyne.

Building Concrete Box Substructure for Hudson River Pier



Construction proceeds rapidly on concrete box substructure for large Hudson River pier, designed to replace Pier 57 on Manhattan waterfront which burned in 1947. Construction site is pumped out lake bed along Hudson River near Grassy Point, N. Y., separated from the river by a thin embankment. When the three 27,000-ton concrete boxes are completed this spring, the lake bed will be flooded again and the boxes floated 35 miles down the Hudson and into position at West 15th Street. Photo shows south half of Box No. 3, with sidewall buttress cages and interior columns in temporary position. Merritt-Chapman & Scott and the Corbetta Construction Company, of New York, are joint construction companies on project. An article on the project will be published in the March issue of "Civil Engineering."

Experiment in Generating Atomic Power Reported

Successful production of small amounts of electric power from heat energy released in the operation of the experimental breeder reactor recently completed at the National Reactor Testing Station in Idaho, is announced by A. Lamitage, manager of the Chicago Operations Office of the Atomic Energy Commission. In a trial run on December 21 and 22, more than 100 kw of electrical power was generated and used to operate the pumps and other reactor equipment and to provide light and electrical facilities for the building housing the reactor equipment. The heat energy generated was removed from the reactor by a liquid metal at a temperature high enough to generate steam to drive the turbine.

The new reactor was designed and is being operated by the Argonne National Laboratory at Lemont, Ill., the reactor research center run for the AEC by the University of Chicago. The tests were supervised by Walter H. Zinn, laboratory director, and H. V. Lichtenberger, laboratory project engineer for the experimental breeder reactor. Test operations will be resumed early in 1952 after further adjustments of the reactor system.

The principal function of the breeder reactor is the long range goal of converting non fissionable material into fissionable material more rapidly than nuclear fuel is consumed—a project that will contribute to expansion of the current atomic weapons program. Although the power generation phase is incidental, it is being carried out to secure experimental information on the handling of liquid metals at high temperatures under radioactive conditions and on the extraction of heat from a reactor for useful purposes.

Authorities emphasize that no comparisons should be made of the cost of producing electric power from the reactor with conventional production costs. The experiment is not intended to establish the feasibility of producing electrical power economically from nuclear sources. The technical information gained, however, is expected to be useful in the design of future reactors aimed at generating electricity at competitive costs.

The reactor and its principal components were erected at the Idaho testing station by the Argonne National Laboratory. Design of the building and some of the reactor system was handled by the Austin Company, Cleveland. Construction was by the Bechtel Corporation, of San Francisco, under the supervision of the Idaho Operations Office of the AEC headed by L. E. Johnston. Total construction cost was about $2,700,000.

A. P. Richards to Head Marine Research Laboratory

A. P. Richards will succeed the late Dr. William F. Clapp as president and director of the William F. Clapp Laboratories, Inc., at Duxbury, Mass. Dr. Clapp, who died on December 28, was an internationally known authority on destructive marine organisms, and the laboratories have accumulated exceptionally extensive records of the incidence and destructive effects of such organisms from tests made all over the world. The laboratories have also studied many other forms of biological deterioration, such as the action of bacteria and fungi on cordage and other fibres, salt water corrosion and protective coatings, and control of the fouling of ships and power plant cooling tunnels by the use of anti-fouling compounds and thermal treatment.

Mr. Richards has been principal assistant to Dr. Clapp on the marine research work for the past 16 years.

Science Foundation Issues Research Grant Guide

A tentative guide to assist scientific research investigators in the preparation of proposals for National Science Foundation research grants is being distributed to universities and colleges, laboratories, and other organizations in a position to carry on competent scientific research. Copies may be obtained from the Foundation, 2144 California Street, N.W., Washington, D.C.

As announced in the January issue, the Foundation will support basic research in the mathematical, physical, medical, biological, and engineering sciences by making grants for such research to educational, industrial, government, or other institutions. In reviewing proposals, the Foundation will give primary consideration to the scientific merit of suggested projects, including the competence of the scientist under whom the study will be made. The Foundation has earmarked approximately $1,500,000 for support of basic scientific research during the current fiscal year.

Welding Contest Is Open to Undergraduates

Rules and conditions governing the fifth annual competition of the Lincoln Arc Welding Foundation's Engineering Undergraduate Award and Scholarship program are now available in a 24-page illustrated booklet. Established to encourage undergraduates to "use imagination and ingenuity in developing an engineering project in their own field," the program offers awards totaling $6,750 for the best papers on design of machines or structures, or separate components of machines or structures, in which arc welding is the method of fabrication. Welding research and maintenance projects can also be described. Scholarship funds totaling $1,750 are also awarded to schools.

Rules booklets may be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

Navy Continues Large Construction Program

Major construction projects to be launched by the Navy Civil Engineer Corps in 1952 include a $6,500,000 electric, electronics, and ordnance shops building at the Portsmouth, Va., Naval Shipyard. A contract for the design work has been awarded to Harley, Ellington and Day, Inc., of Chicago, and Hayes, Seay, Mattern and Mattern, of Norfolk, Va. Construction will be undertaken under a lump sum competitive bid contract, for which bids will be advertised early in the spring.

Two special classroom buildings for coordination of three advanced technical training schools will be built at the Naval Training Station at Great Lakes, Ill. These structures, which will cost $4,000,000 are being designed by Skidmore, Owings and Merrill, a Chicago architectural and engineering firm. Working drawings will be ready by spring. Designs are also being developed for a $4,000,000 Fleet Air Defense Training Center, to be established at Point Loma, Calif. The Fluor Corp., of Los Angeles, is preparing plans and specifications. When completed, probably early in 1953, the center will be the only one of its kind on the West Coast. Construction of the first increment of permanent facilities for the Naval Post Graduate School, which has been established as a separate training activity at Monterey, Calif., is expected to start in the spring. Initial construction work will cost about $5,400,000.

The first major airstrip construction in the Navy's $300,000,000 aviation building program will be launched in Texas. Plans and specifications are being completed for new runways at the Corpus Christi Naval Air Station and at Chase Field, 40 miles away. Lockwood and Andrews, architectural and engineering firm of Houston, Tex., is making working drawings for the Corpus Christi runway that will be built parallel to an existing strip. The landing strips and related facilities will cost about $6,000,000.

A $2,500,000 program for modernization of the Niagara Falls, N.Y., Naval Air Station will also be undertaken. Cannon, Thiele, Betz and Cannon, of Niagara Falls, are engaged on the construction plans. Among other facilities that will be expanded and improved are the Portsmouth, N. H., shipyard; the New Orleans Naval Station; the Naval Air Station at Key West, Fla.; and the Cherry Point, N. C., Marine Corps Air Station.

Steel Companies Combine

To simplify its corporate structure, the United States Steel Company has combined the Columbia Steel Company and the Geneva Steel Company into a single operating division, to be known as the Columbia-Geneva Steel Division of the United States Steel Company. Headquarters for the Division will be the Russ Building in San Francisco.

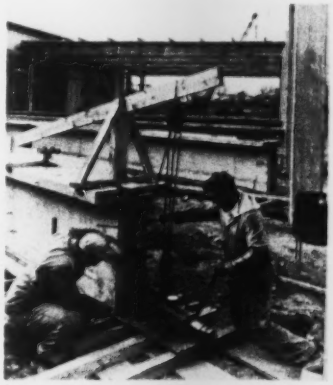
Industrial Application of Prestressed Concrete Saves Steel

First industrial application of prestressed concrete techniques is reported by the Austin Company, Cleveland engineers and builders. Following extensive investigation of alternative designs to structural steel to cope with emergency shortages, the company found that "Prestressed concrete offered by far the greatest possibilities, using less than one third the steel required for ordinary steel framing." As a result of these findings, the company developed 60-ft prestressed concrete beams weighing about 13 tons apiece for use in building an addition to the plant of the F. W. Wakefield Brass Company at Vermilion, Ohio. The girders, longest of the kind ever constructed in this country for buildings, contained 60 strands of $\frac{1}{4}$-in. dia high-strength wire.

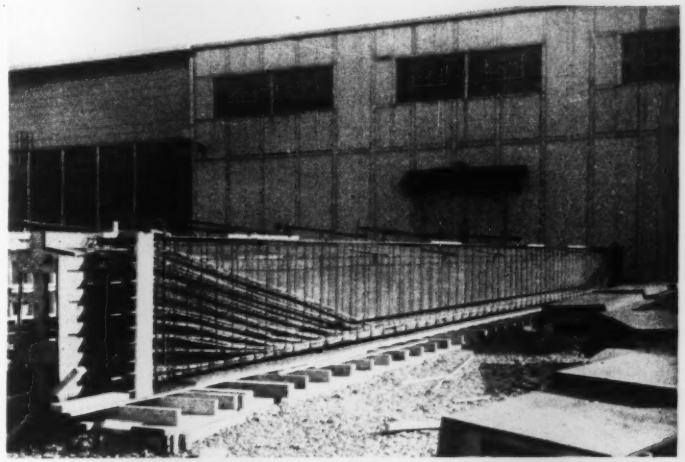
The wires, which had a specified minimum ultimate strength of 215,000 psi and registered a minimum of 220,000 psi under laboratory tests, were grouped in ten double cables of three wires each and wrapped in a special waterproof paper after application of an asphaltic material to prevent binding and the possibility of corrosion. The cables were post tensioned to a peak of 145,000 psi by a center hole 60-ton hydraulic jack. However, allowance for shrinkage and plastic flow indicated an actual working stress of 123,000 psi. One-quarter inch diameter stirrups spaced 12 in. apart in the central portion of the beam and at closer intervals within 5 ft of the ends were used to align the cables and supplementary reinforcing, which included a number of $\frac{3}{4}$-in. dia longitudinal bars along the top and bottom of the beam.

Concrete with a maximum slump of 2 in. and designed for a compressive strength of 5,000 psi was used in the beams, which are 40 in. deep with a 30-in. top flange and a 6-in. web, except at the bottom where there is a 12-in. flange 8 in. thick. The reinforced concrete columns supporting the beams were cast in place with reinforcing members, to which the beams and precast concrete struts were welded to obtain a completely integral frame. The columns and horizontal struts at the tops of the columns are ordinary reinforced concrete.

Only the 60-ft girders are prestressed. The columns and horizontal struts at the tops of the columns are of ordinary reinforced concrete, and the purlins and girts of structural steel.



Cables were post-tensioned to peak of 145,000 psi by center-hole 60-ton hydraulic jack shown at right. View below shows cables and mild steel reinforcing substantially in place, with plywood forms ready for erection on exposed side.



Army Engineers Announce 1952 Planning Projects

The 1952 civil works planning program of the Corps of Engineers will include 24 flood control and 11 river and harbor projects, located in 20 states, the District of Columbia, and Hawaii, according to an announcement from Lt. Gen. Lewis A. Pick, M. ASCE, Chief of Engineers.

In October, Congress specifically earmarked planning funds for three Kansas projects—Tuttle Creek, Strawn, and Toronto reservoirs. Except on these three projects, no planning can be undertaken or continued without certification by the President as necessary to the defense effort. Listed projects, for which funds totaling $3,918,100 are available, include the Howell Mill Shoals Dam in Alabama, the Upper Columbia Lock and Dam in Alabama and Georgia, Table Rock Reservoir in Arkansas and Missouri, Pommels Tyre Reservoir in Missouri, and Carthage Dam in Tennessee.

Contract Awarded for Ordnance Depot Unit

Award of a contract to construct a 240,000-sq ft general supply warehouse at the Erie Ordnance Depot at Lacarne, Ohio, to the H. K. Ferguson Company, industrial engineers and builders, is announced by the Huntington, W. Va., District of the Corps of Engineers. The contract covers site clearance, construction of the 200 by 1,200 ft structural steel and masonry warehouse building, and installation of servicing facilities and a railroad spur and bituminous roads.

Cost of the project is estimated at approximately $2,000,000.

Canada Continues Program of Hydroelectric Construction

Canada continued to maintain a high level of hydroelectric construction during 1951 with 881,250 hp of new capacity going into operation, according to a recent summary of the Canadian Minister of Resources and Development. Although the greatest increase in capacity during the year occurred in the Province of Quebec, with a total installed capacity of 461,700 hp, developments were distributed throughout the country. Power consumption continued to expand during the year, the demand for primary energy being more than 13 percent higher than in 1950.

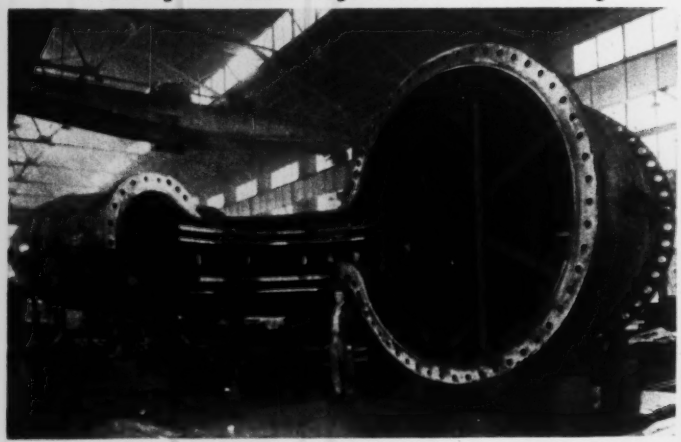
New plants and extensions to existing stations which are under construction for operation in 1952-1953 total more than 1,700,000 hp, and approximately the same amount is under preliminary construction or definitely planned for operation in 1954-1955. A project of outstanding importance to the economy of British Columbia was started during the year when the Aluminum Company of America began preliminary work on the Nechako-Kitimat development. Present plans call for an installation of 420,000 hp by early 1954, but tunnel and transmission line capacity are designed for a total installation of about 1,000,000 hp. The consolidated Mining & Smelting Company of Canada, Ltd., commenced construction of its Waneta plant on the Pend d'Oreille River near its junction with the Columbia. The powerhouse will contain two turbines each rated at 102,500 hp. Operation is scheduled for the spring of 1954.

1951 Increase in Steel Capacity Is Reported

An increase of more than 4.3 million tons in the annual steel capacity of the United States during 1951, bringing production to a record high level of 108,587,670 tons, is reported by the American Iron and Steel Institute.

The steel companies, in a tremendous program of expansion and improvement, have raised the capacity of the largest steel industry in the world more than 17.3 million tons in five years. This increase almost equals the total annual capacity of Great Britain and is about half the estimated total capacity of Russia, second largest steelmaking nation. To support the country's rise in steelmaking capacity, which is expected to reach 120,000,000 tons during 1953, other producing facilities in the industry have been expanded and improved. Blast furnace capacity increased by 1,310,560 tons during the year, and coke-oven capacity by nearly 800,000 tons. Expansion and improvement of finishing mill facilities and other equipment are also reported by the Institute.

Welding Fabricates Huge Turbine Scroll Casing



First large turbine scroll casing to be fabricated by welding by Baldwin-Lima-Hamilton Corp. is being built for 70,000-hp turbine in Detroit Dam power plant under construction by Army Corps of Engineers in Oregon. The 260,000-lb casing is made of seven welded sections of heavy steel plate with flanges for bolting the sections together. Six sections are shown here. Maximum diameter of spiral is 40 ft, and opening at large end (not shown) is 150 in. Advantages of the shop-welded casing over equivalent casing design in cast steel are its lower weight and cost.

Predicts More Use of Steel in Bomb-Proof Building

Increasing use of structural steel to assure construction resistant to atomic bomb blast was predicted by John D. Griffiths, Assoc. M. ASCE, district engineer for the American Institute of Steel Construction, in a talk before the Institute's recent annual convention in White Sulphur Springs, Va. Representing the steel fabricating industry on an engineering panel established by the Civilian Defense Administration, Mr. Griffiths reviewed the opinion of experts who have been studying the effect of atomic bomb blast on building structures.

(*Continued on page 68*)

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

Tried Double Azimuths Lately?

"Most of my 45 years as engineer and surveyor have been with the New York City Board of Water Supply, helping build its famed reservoir system," says Herbert Dibbell, Shokan, N. Y. "One interesting job was a preliminary surface profile for the 30-mile West Branch-Kensico tunnel of the Delaware Aqueduct.

"Here, tentative shaft sites were plotted on U. S. G. S. sheets and aerial photos and connected with the proposed tunnel alignment. An azimuth was determined near the first shaft site by 'equal altitudes of the sun' and subsequent azimuth observations were made at intervals of five or six miles.

"The terrain was heavily wooded; promiscuous cutting was taboo. We ran a series of courses, staying close to the proposed alignment and avoiding as many obstacles as possible. Position of each transit point, with reference to alignment, was computed. Offset shots were taken from the transit points to locate the profile. Frequent checks were made against the photos and the predetermined azimuth was revised to agree. Distances and elevations were determined by stadia.

At Shokan Reservoir, which he helped plan in 1908, Herbert Dibbell levels with his Gurley Transit.

Dibbell graduates tripod leg, swings bob over to determine H. I. quickly. Pocket (right) holds bob.

"To determine angular measurements by repetition, we employed 'double azimuths'—an efficient, speedy method seldom used, I understand, by most surveyors.

"Here's how it works: set the back azimuth; sight on backsight and turn to foresight; read forward azimuth; loosen lower motion, sight on backsight and turn to foresight; read horizontal circle (all as in ordinary repetition). *Then:* add the back azimuth to reading and divide by two; if necessary, add or subtract 180°. Result should compare with the first forward azimuth. Angular closure is evident immediately—obviating addition of interior angles and aiding transference of angular work into bearings.

"I recommend this method to all surveyors – just as I do my new Gurley Hell Gate Transit. With Gurley optics, I see the plumb string on the shadiest day. And that accurate, versatile reversion bubble gives me a real *dual-purpose instrument.*"

We'd like your story for a future page in this series. Drop us a line...we'll contact you for details later. Ask for Bulletin 50 giving complete data on Gurley instruments.

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Anticipated changes in building design include a trend toward the use of steel columns in place of masonry, use of more rigid connections in multi-story buildings, with resulting increase in the use of welding, designs for withstanding heavier wind loads, especially for one-story structures, greater attention to requirements for bracing and more use of single-span rigid-steel frames and use of blast walls around the core of multi-story structures to provide barriers against missiles and to increase the lateral strength of the structure.

Institute Seeks Solution to Engineer Shortage

Increasing the quantity and quality of the engineering and scientific manpower of the United States was the objective of a recent two-day Thomas Alva Edison Institute for Science Teachers. Attributing England's industrial decline and loss of world leadership to failure to train and utilize adequate numbers of engineers and applied scientists "necessary to competitive strength and growth in our modern technological civilization," the Institute warned that the United States may be headed in the same direction.

Present industrial requirements in the United States, the Institute brought out, show 80,000 vacancies. For normal non-military requirements, industry regularly requires 30,000 engineers annually. The supply indicates that 26,000 will be available in 1952, 17,000 in 1953, and 12,000 in 1954. With military requirements taking about half of each graduating class, "the problem of arresting the decreasing output of engineering schools and sharply increasing the supply by 1956, is one of the most important priority jobs facing the United States today," the conference emphasized.

To meet the challenge, the Institute mapped a program for government, industry, education, and the public to follow in seeking to interest present high school students in selecting careers in engineering and science.

Topographic Instructions of Geological Survey Revised

The Topographic Division of the U.S. Geological Survey is completely revising its Topographic Instructions, according to an announcement from Gerald Fitzgerald, chief topographic engineer. The new instructions will be of the loose-leaf type to facilitate the separate issuance of individual chapters as completed, and to provide a convenient means of maintaining continuous revision in the future. To date four chapters of the new manual 1A1, 1A2, 2F5, and 6A3 have been published.

To facilitate distribution, Chapters 1A1 and 1A2, explaining the instructions and listing the 176 individual chapters now in preparation, have been bound in a folder, identified as Circular No. 92. Each group of chapters comprising a complete unit of the instructions will be similarly bound together for issuance as a Geological Survey Circular. Copies of each circular can be supplied free to those making specific request at the time of issue from the U.S. Geological Survey, Washington, 25, D.C.

Neare's N. G. COLUMN

R. Robinson Rowe, M. ASCE

The Engineers Club of Esseyeville had a new president. Joe Kerr laughed when he rapped for order. "The Professor waves the gavel like he was pointing at the blackboard," he joshed, but Stoop Nagle, called upon as Guest Professor, frowned him down.

"If Joe's so smart tonite," challenged Stoop, "let's hear his solution to the problem of Archie's Xmas blocks."

"Maybe you will," retorted Joe. "I guessed right away that the gismoud blocks had to be disks if one was always stable when it covered the center dot of another. For a pile of three disks to be stable, as in the sketch, the centroid C of the two upper disks must be above the lower disk. Letting the disk radius be 2, BM and MI cannot exceed 2, MC cannot exceed 1, and C must not fall in the lune DE, described by radii $BD = 2$ and $MD = 1$. How'm I doin' so far?"

"All right, but Cal Klater's fidgeting."

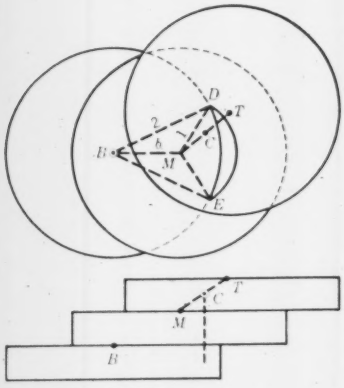


Fig. 1. Archie's two top blocks topple if midpoint C falls in the line DE

"Thanks, but now I start guessing. BM, which I'll call b, varies from 0 to 2. For any b, the chance of toppling is the ratio of the area of the lune to the whole circle about M. This chance is zero until $b = 1$ and must be about ½ when $b = 2$ because it isn't 1 until $b = 3$. The average up to $b = 2$ is 0.125, which is my guess."

"Not bad, not good," conceded Cal, "in fact a good start and a poor finish. As Joe said, for any b the chance of tipping is L/π, where π is the area of the whole circle and the area of the lune is

$$L = \tfrac{1}{2}\sqrt{16 - (3 - b^2)^2} + \cos^{-1}\frac{3 - b^2}{2b} - 4\cos^{-1}\frac{3 + b^2}{4b} \quad (1)$$

This is a function of b and must be integrated over the locus of b, which is the area $\int_0^2 2\pi b\,db = 4\pi$. Hence the probability is

$$P = \frac{1}{4\pi}\left(\int_0^1 0 + \int_1^2 L\right)2\pi b\,db = \frac{1}{2\pi}\int_1^2 Lb\,db \quad (2)$$

Then substituting for L its value in (1) and integrating,

$$P = \frac{1}{16\pi}\left[(b^2 + 5)\sqrt{16 - (5 - b^2)^2} + 4b^2\cos^{-1}\frac{3 - b^2}{2b} - 16b^2\cos^{-1}\frac{3 + b^2}{4b} - 16\cos^{-1}\frac{5 - b^2}{4}\right]_1^2 = \frac{3}{16\pi} \times \left(3\sqrt{15} - 32\sin^{-1}\tfrac{1}{4}\right) = 0.2108713"$$

"What a man!" conceded Joe.

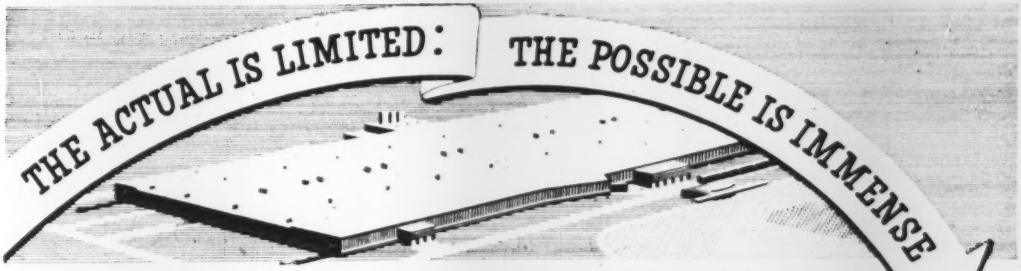
"But I'll wager," said Professor Nagle, "that even Cal wouldn't want to figure Archie's chance of piling four blocks. Mr. Chairman, I worked Cal overtime. I hope you have an easier one for next time."

"I have a Guest Professor who has," answered President Neare. "Professor Will Metter, a new member, wants to tell you about a race around a barn."

"It was a big red rectangular barn," said Will, "200 ft long by 100 ft wide and facing south. A collie at the southwest corner started for a heifer at the northwest corner, and the race was on, clockwise around the barn, each doubling speed as a corner was turned, and neither being able to catch the other. After eight rounds the heifer saw the collie rounding the corner ahead of her. What was her starting speed?"

"A heifer like that is fit to be tied," concluded the Professor. "Meeting adjourned."

[Cal Klaters were Sauer Doe (Martin) Larson and R. E. Philleo. Guest Professors were John L. Nagle and Frank A. Randall, Jr. Also acknowledged is a final solution of the November perfect-triangle problem from Don T. (Don Thayer).]



NEW LINCOLN PLANT CREATED BY INCENTIVE INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

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WELDED FRAME DESIGN CUTS STEEL TONNAGE 15%

THROUGH welded structural design, it has been possible to save 15% on steel in the framework for J. W. Robinson's new department store in Los Angeles. The most recent department store in Southern California, this 1700 ton frame is almost entirely field welded.

The relationship of the columns and girders provides both vertical and horizontal continuity with a minimum of welding. The horizontal continuity reduces the deflection of the 32 ft. beam and girder spans to approximately 25% of what it would have been if they had been simply supported.

All girders are continuous through the column lines—the column rather than the girder being spliced at that point—and extend to a point approximately 6.5 ft. from the columns on both ends. This leaves a space in alternate spans of approximately 19 ft. between girder ends in which a suspended span is carried.

This design idea also allows any variations in gap to be compensated in the splice welds and so further simplify field welding.

Approximately 6" less height per story results from this welded frame design. Distances between ceiling of one floor and the floor level above are also considerably less than with other types of construction.

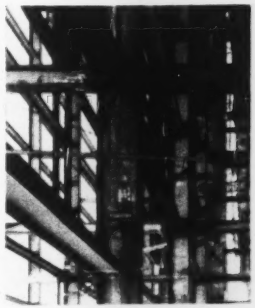

Fig. 4. Continuous Girder *passing over column top is spliced at point of minimum stress.*

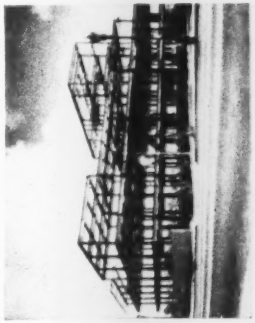

Fig. 3. Four Story Rigid Frame *for the J. W. Robinson department store in Los Angeles, California. Architects: Perera and Luckman and (Claire O. Matcham. Structural Designing and Detailing: Paul L. Jeffers and Robert Haider, Associate Structural Engineers. Steel Fabricators: Bethlehem Pacific Coast Steel Corporation.*

WELDED DESIGN ALWAYS SAVES STEEL AND LOWERS COST

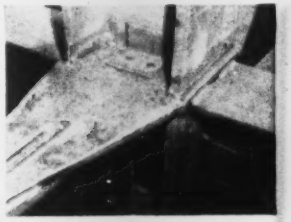

Fig. 1. Typical Column Joint — *Develops continuity both vertically and horizontally. Vertical column continuities are shop welded to the continuous beam. Top plate, with slot to give extra weld area, develops continuity in transverse beams across column supports.*

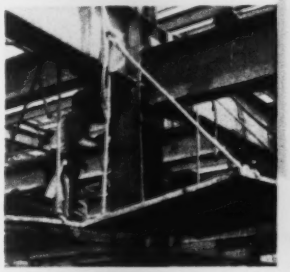

Fig. 2. Detail of Girder *running through column. Column top and base are welded to beam flange. Vertical stiffeners provide continuity to column.*

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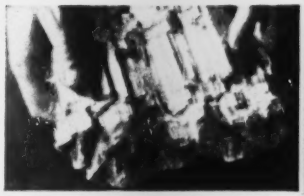
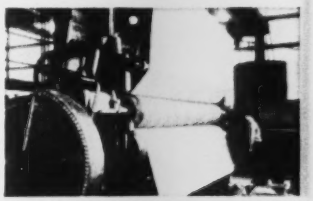


Tough, strong asbestos fibers reinforce Transite Pipe—contribute to its high corrosion resistance and lasting strength.



On machines like this, the asbestos-cement-silica mixture is "built up" under heavy pressure into a dense, homogeneous pipe structure.

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Prizes Offered for Papers on Resistance Welding

Six prizes totaling $2,250 will be given by the Resistance Welder Manufacturers' Association for outstanding papers dealing with resistance welding subjects. For the best papers emanating from an industrial source, consulting engineer, private or government laboratory, or the like and dealing specifically with resistance welding, prizes of $750, $500, and $250 are available. Other prizes of $300, $250, and $200 will be given for the best papers coming from a university, instructor, graduate or undergraduate students, or research fellows.

Further information concerning the contest, which closes July 31, 1952, may be obtained from the Resistance Welder Manufacturers' Association, 1900 Arch Street, Philadelphia 3, Pa. Contest judges will be appointed by the American Welding Society, and awards will be made at the 1952 fall meeting of that society.

Proposed Rogue River Dam Site Is Found Unsuitable

A long expensive dam would be required at the proposed Mile 186.5 dam site on the Rogue River, Oregon, according to the U. S. Geological Survey in a report just made public. The site was inspected and the report prepared by J. C. Miller, Survey geologist, after a map reconnaissance by Department of the Interior engineers indicated it might make a good reservoir location. Examination of the site showed, however, that over the centuries the river had developed a broad flood plain and that, in more recent times, a large quantity of volcanic ash was deposited over it, with the result that a dam or cutoff wall of excessive length would probably be needed to prevent leakage through these soft beds.

Copies of the report are available for study in Geological Survey offices in Washington, Los Angeles, and Portland, Oreg.

Report on Nation's Ground Water Released

Availability of the first comprehensive compilation of ground water data on a nation-wide scale is announced by the Department of the Interior. Constituting the major part of the Geological Survey's report to the President's Water Resources Policy Commission, the compilation has been issued as Survey Circular 114, entitled "The Water Situation in the United States, with Special Reference to Ground Water."

The report discusses the effects of climatic changes on ground water, the relation of ground water to stream flow, the importance of chemical quality of water, and the effects of various land use practices on ground water. It describes the operation of underground reservoirs as a phase of over all water resources development, and presents data on the importance of ground water in the national economy. A summary of current conditions in the principal regions of the United States and a reading list of important hydrological references are included.

Inquiries concerning the report, which was written by C. E. McGuinness, should be addressed to the U. S. Geological Survey, Washington, D. C.

Aluminum Nails Are Found Non-Staining

Use of aluminum nails to prevent nail staining of cedar shake and cedar shingles has been officially approved by the Red Cedar Shingle Bureau, according to an announcement from the manufacturer, the Nichols Wire & Aluminum Co., of Davenport, Iowa. Approval was based on completion of extensive tests on use of aluminum alloy nails in red cedar siding shakes, and shingles made by the Aluminum Research Laboratories.

DECEASED

Culver Martin Ainsworth (M. '39) since 1927 chief engineer for the United States section of the International Boundary Commission, at El Paso, Tex., died on December 22. His age was 62. Early in his career Mr. Ainsworth worked for the Oregon Short Line, the City of Caldwell, Idaho, and as assistant engineer for the U. S. Bureau of Reclamation, at Boise, Idaho. As chief engineer for the International Boundary Commission, he directed many surveys that led to the construction of flood control, sanitation, fencing, and water control projects. He studied at Grand Island College and the University of Nebraska.

C. M. Ainsworth

Lansing Wheeler Althof (M. '29) for some time district engineer for the Union Pacific Railroad Co., at Portland, Oreg., died on December 11, at the age of 65. Mr. Althof was first engaged by the Southern Pacific and the Oregon Short Line railroads. Subsequently he became division engineer of the southwest district of the Union Pacific Railroad, at Los Angeles, Calif.; district engineer of the eastern district; and division engineer and district engineer, at Portland.

Theodore Alexander Beyer (M. '19) for several years head of the Beyer Construction Co., at Los Angeles, Calif., died some time ago though notice of his death has just been received at Society Headquarters. He was 63. Mr. Beyer had been connected with the Great Northern Railway, at St. Paul, Minn.; the Minneapolis (Minn.) Steel & Machinery Co., at Salt Lake City, Utah; and James J. Burke & Co., at Salt Lake City. He graduated from the University of Minnesota.

Geoffrey Arthur Caffall (Assoc. M. '17) retired engineer of Pittsburgh, Pa., died on June 2, though word of his death has just reached the Society. His age was 65. For many years Mr. Caffall was manager of erection for the Pittsburgh district of the Bethlehem Steel Co. and its predecessor organization, the McClintic-Marshall Co. He retired recently. He was a Lehigh University graduate.

William Clarkson (Assoc. M. '16) president of the Oil City Iron Works, at Corsicana, Tex., died on November 3, at the age of 64. Mr. Clarkson was first associated with the Texas Co., the Magnolia Petroleum Co., and George A. Duren, consulting engineers. In 1911 he joined the Oil City Iron Works, at Corsicana, becoming successively assistant manager, chief engineer, and president. He received his training at the Armour Institute of Technology.

Victor da Silva Freire (M. '06) director of the City of São Paulo Imports & Freehold Land Co., at São Paulo, Brazil, died some time ago though notice of his death has just reached Headquarters. His age was 82. During his career Mr. da Silva Freire was assistant engineer for the Societe International des Travaux Publics et Chemins de Fer, at Liege, Belgium, and executive engineer for the Department of Public Works and superintending engineer for the sanitation department, State of São Paulo, Brazil. He later became chief engineer and director of municipal works for the City of São Paulo and professor of graphic statics and strength of materials for São Paulo State's Polytechnic School. He graduated from École des Ponts et Chaussees.

Loran DeLancey Gayton (M. '32) since 1941 assistant city engineer for Chicago, died on December 28, at the age of 71. From 1904 to 1907 he was with O. E. Strehlow of Chicago; from 1908 to 1910 with G. E. Kahn of Milwaukee, Wis.; and in 1913 he was in charge of construction of the Gordon Ferguson building in St. Paul, Minn. In 1914, Mr. Gayton went to work for the City of Chicago and served as designing engineer, assistant engineer of waterworks design, engineer of waterworks and city engineer. He was educated at the University of Illinois. Mr. Gayton was active in the Illinois Section.

Jose Celso Cao-Garcia (Assoc. M. '50) engineering, construction, and maintenance manager for ESSO Standard Oil of Central America, at Panama City, Panama, died on December 6, at the age 35. Mr. Cao-Garcia had worked for the Frederick Snare Corp., at Guantanamo Bay, Cuba, and Pan American Airways in the Dominican Republic and Miami, Fla. Since 1943 he had been connected with the ESSO Standard Oil (C.A.), serving successively as assistant technical manager and acting technical manager at Havana, and engineering adviser in the Canal Zone. He graduated from Rensselaer Polytechnic Institute.

Ralph Hamilton Chambers (M. '04) retired consulting civil engineer of New York, N.Y., died on December 22, at the age of 80. Mr. Chambers had been with the King Bridge Co., at Cleveland, Ohio, and Boston, Mass., vice president and chief engineer for the Jarrett-Chambers Co., and vice president and director of the Foundation Co. An authority on skyscraper foundations, he designed the caissons that were added to the foundation of Trinity Church and had served as an adviser on the drafting of the New York City Building Code. He was a graduate of Rensselaer Polytechnic Institute, from which he received an honorary doctor of engineering degree in 1937.

Raymond Francis Fletcher (M. '47) senior architectural and civil engineer for E. I. du Pont de Nemours Co., of Wilmington, Del., died some time ago according to word just received at Society Headquarters. He was 49. Mr. Fletcher had been associated with Ritter & Shay, at Philadelphia, Pa., Gravell & Duncan, at Philadelphia, and Fred W. Abbott. In 1934 he joined E. I. du Pont de Nemours & Co., successively becoming assistant to the project engineer, process engineer, and senior architectural and civil engineer. He was educated at Drexel Institute of Technology.

Edward Crawford Long (M. '45) retired engineer of Athens, Ga., died on October 31, at the age of 70. Mr. Long had been with the American Bridge Co., at Pittsburgh, Pa.; the Virginia Bridge Co., at Roanoke, Va.; and several steel companies in Pennsylvania. He was connected with the Nashville Bridge Co., at Nashville, Tenn., from 1924 to 1932, and for some time engaged in contracting work in Athens, Ga. More recently he was structural engineer for the Steel Products Co., Inc., at Savannah, Ga. He attended Georgia Institute of Technology.

O'Kelly William Myers (M. '22) retired engineer of East New Market, Md., died on December 10. His age was 71. Mr. Myers did river and harbor and other improvement work for the U.S. Engineers at Fort Caswell, N.C., Fort Wool, Va., and Boston, Mass. From 1910 to 1917 he was assistant engineer and section engineer on tunnel construction for the New York City Board of Water Supply. He was also engaged by various municipalities and consulting firms, including Buck, Seifert & Jost, of New York City. He graduated from North Carolina State College.

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Walter William Colpitts (M. '05) consulting engineer of New York City, died on December 23. He was 77. At the start of his career Mr. Colpitts was with the Canadian Pacific and the Kansas, Mexico & Orient railways. He entered partnership with the late William H. Coverdale, of New York, in 1913 and practiced engineering under the firm name of Coverdale & Colpitts. He was responsible for carrying out the management, reorganization, and financing of railway properties, and from 1938 to 1943 was chairman of the reorganization committee of the Minneapolis and St. Louis railroads. He was educated at McGill University.

Walter W. Colpitts

Benjamin Franklin (M. '06) senior partner in the consulting firm of Franklin & Lindsey, of Philadelphia, Pa., died on October 30, at the age of 90. At the start of his career Mr. Franklin was with the Philadelphia Water Department and on the civil engineering faculty at the University of Pennsylvania. He subsequently became a member of the firms of Franklin & Evans, Haupt & Franklin, and worked for various railroads in Pennsylvania, New Jersey, and Iowa. He served as director of the Philadelphia Section of the Society (1919–1921) and as president (1921–1922). He was a graduate of the University of Pennsylvania.

Wesley Miles Hall (M. '47) for several years general contractor of Brownwood, Tex., was killed in an automobile accident on August 1, at the age of 46. Mr. Hall was engaged on the design, location, and construction of highways and bridges for the Texas State Highway Department, serving as resident engineer of District 23 from 1935 to 1940. He then became construction engineer for the Morgan Uvalde Construction Co., at Camp Bowie, Tex., and later established his own general contracting business in Brownwood.

Walter Hovey Hill (M. '01) of Grangeville, Idaho, died on June 10. His age was 82. Mr. Hill began his career with the Atchison, Topeka & Santa Fe Railroad in Kansas City and Colorado. Subsequently he served various water and mining companies and railroads in Virginia and Idaho. He had been engaged in private engineering practice in the West for over 40 years.

Lyle Loren Jenne (Assoc. M. '25) sanitary engineer for the Bureau of Water, at Philadelphia, Pa., died recently. He was 63. Mr. Jenne had been with the Bureau of Surveys at the Philadelphia Experiment Station, the City of Pittsburgh, Pa., and the Bureau of Water, at Philadelphia. He also acted as consultant to various water companies. Active in Society affairs, he had served the Philadelphia Section as vice president and director. He received his education at the University of Pennsylvania.

Richard Hubert Pennartz (Assoc. M. '20) for the past six years assistant engineer for Wyandotte County, Kansas, died on May 16, at the age of 63. Mr. Pennartz had been with the City of Fort Madison, Iowa, the Hamilton Water Co., at Keokuk, Iowa, Stone & Webster, the Illinois and Kansas highway commissions, and several construction concerns. Later he became resident engineer on federal-aid roads in Shawnee County, Kansas, and superintendent of CCC projects in Ohio, Pennsylvania, Oklahoma, and Kansas. He was a past president of the Kansas City Section of the Society.

Harold Fred Percival (Assoc. M. '28) for a number of years sales representative for the California Corrugated Culvert Co., at Berkeley, Calif., died on December 4. He was 62. At the outset of his career Mr. Percival did railroad and mining engineering work in Canada and California. He was later associated with the U.S. Engineers; C. M. Phinney, in Sacramento, Calif.; and the Sutter Basin Co. and the Kings County Development Co. He also engaged in private business. He was educated at the California School of Mechanical Arts and the University of Nevada.

Leslie Alexander Pettus (M. '39) for several years loan officer for the Modern Real Estate Loan Co., at St. Louis, Mo., died on July 8. He was 57 and a Washington University graduate. For many years he was engaged by the City of St. Louis, Mo., in various engineering capacities, including assistant civil engineer, civil engineer, and division engineer in charge of design and construction of sewers and paving. He had also been affiliated with the Hydraulic Press Brick Co., and Sverdrup & Parcel, consulting engineers of St. Louis.

Alfred Jones (Assoc. M. '19) retired engineer of Pasadena, Calif., died on December 17, at the age of 74. Early in his career Mr. Jones worked for the Illinois Central Railroad in Mississippi, Tennessee, and Indiana, and the Baltimore & Ohio and Santa Fe railroads. He joined the Los Angeles (California) County Surveyor's Office in 1912 as a draftsman, advancing to chief deputy in 1917 and county surveyor in 1934. He retired in 1947. In 1953 he served as president of the Los Angeles Section of ASCE. He received his degrees from Purdue University.

Alfred Jones

Byrd Moore Williams, Jr. (M. '37) retired engineer of Salt Lake City, Utah, died on December 14. He was 68. Mr. Williams had been construction engineer for Fort Worth, Tex., retiring in 1950 after 26 years of municipal service. Earlier in his career he had been city engineer for Gainesville, Fla., and El Paso, Tex., and harbor engineer for Los Angeles, Calif. He graduated from the University of Texas.

Archie Burton Pierce (M. '23) retired civil engineer of Carmel, Calif., died on November 15, at the age of 83. From 1892 to 1912 Mr. Pierce taught mathematics at California and Michigan universities. He then joined Mayberry & Parker, engineers of Los Angeles, becoming designing engineer and structural designer. For many years he served the Pacific Light & Power Corp., and its successor firm, the Southern California Edison Co. in various engineering capacities. He was educated at California, Harvard, and Zurich universities.

Howard Sawyer Reed (Assoc. M. '11) retired engineer of Phoenix, Ariz., died on November 12, at the age of 83. Mr. Reed was first affiliated with Moore & Co., engineers and contractors of Boston, Mass.; the Nicaraguan and Isthmian canal commissions, and the U.S. Geological Survey, in Washington, D.C. From 1905 to 1913 he worked for the U.S. Bureau of Reclamation on the Salt River Project in Arizona. He later became city engineer of Phoenix, Ariz., director of the Arizona Public Works Administration, and state engineer for Arizona.

James Reese Schick (M. '10) retired engineer of Roanoke, Va., died some time ago. His age was 95. Mr. Schick was with the Pennsylvania State Geological Survey, the U.S. Capitol & Treasury Department, and the Pennsylvania Railroad. Later he had been connected with the Norfolk & Western Railway, serving successively as chief draftsman, assistant engineer, and engineer of construction. He received his training at Lafayette College.

Wilson Alexander Smith (Assoc. M. '44) assistant division engineer for the Alabama State Highway Department, at Grove Hill, Ala., died on October 21. He was 43. Mr. Smith had been with the Alabama State Highway Department since 1928 as project engineer, resident engineer, and assistant division engineer.

George Aymar Taber (M. '06) for several years president of Pennell, Dearborn & Hovey, Inc., at Lynn, Mass., died on November 30. His age was 81. Mr. Taber's experience included work with several civil engineers and contractors in Boston, Mass., and New York City. He had also been assistant engineer for the New York Rapid Transit Commission, the Department of Water Supply, Gas & Electricity, and the Aqueduct Commission. He graduated from Massachusetts Institute of Technology.

Warren Bertram Travell (M. '18) consulting engineer of San Bernardino, Calif., died on November 14, at the age of 79. During his career Mr. Travell was chief engineer for the Tennessee Natural Development Co., at Greenville, Tenn.; the Atlas Portland Cement Co., Butterworth-Judson Corp., and E. F. Terry Manufacturing Co.—all with headquarters in New York City. He was also chief engineer for the California Portland Cement Co. from 1922 to 1930, entering private practice in the latter year. He graduated from Rensselaer Polytechnic Institute.

Hugh Edward Young (M. '26) of Ashton, Ill., died on November 28, at the age of 65. After his graduation from the University of Iowa, Mr. Young was employed successively by the Illinois Steel Co.; the American Bridge Co.; and several railroads. Later he was engineer of bridge design for the City of Chicago; consulting engineer for the Wayne County Road Commission, at Detroit, Mich.; and chief engineer for the Chicago Plan Commission. He had also acted as consultant to the commissioners of Lincoln Park and South Park, Ill.

Hugh E. Young

Montgomery Waddell (M. '96) consulting engineer of New Canaan, Conn., died on December 21. His age was 80. At the start of his career Mr. Waddell worked for the Colombian Government, the Panama Railroad, and the City of Panama. He then became assistant engineer for the Plaza de Oro Mining Co. in Ecuador, and assistant engineer and location engineer for the Caribbean Manganese Co., Republic of Colombia. In recent years he engaged in private practice. He received his training at Rensselaer Polytechnic Institute.

Carleton Taylor West (Assoc. M. '41) vice-president in charge of operations for the Monolith Portland Cement Co., at Los Angeles, Calif., died recently. His age was 52. Mr. West had been engineer for the Southern California Edison Co. on the Big Creek Project. Later he was engineer, purchasing agent, and vice-president in charge of operations for the Monolith Portland Cement Co. He graduated from the U.S. Engineer School and attended the University of California.

James Theodore Whitney (Assoc. M. '19) consulting engineer of Wakefield, Mass., died on November 28, at the age of 63. Mr. Whitney's experience included work as draftsman for Bigelow & Wadsworth, Boston, Mass., architects, and estimator, treasurer, and president of the Whidden-Beckman Co., now the Whitney Engineering Co. He was a Massachusetts Institute of Technology graduate.

SOLUTION to problem on page 43. The cross-grained blocking at the ends of the columns had gradually squeezed down (wood being much weaker in compression transverse to the grain than longitudinal to it), and cumulative settlement over several of the floors became serious. The solution to the problem was simply to jack up the columns and replace the blocking with metal plates.

This
TRIPLE ACTING
NON-RETURN
VALVE

Automatically

✓ **Opens** when boiler pressure equals header pressure

✓ **Isolates** and prevents back steam flow into a defective or lower steaming boiler

✓ **Prevents** boiler steam flow when steam line or header is ruptured.

GOLDEN-ANDERSON

also makes this Single-Acting Non-Return Valve

which will automatically open to cut-in the boiler when its pressure equals the header pressure and automatically close to isolate the boiler when its pressure decreases.

Bulletins S-1A and S-2 contain complete technical data.

GOLDEN ANDERSON Valve Specialty Company

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NEWS OF ENGINEERS

D. H. McNeal, consulting engineer of Washington, D.C., has become connected with Martin Heflin & Associates, public relations counsel, in Washington.

Alfred D. Wolff, Jr., since 1949 assistant vice president of the New York Central Railroad, has retired after more than 40 years with the company. Mr. Wolff was associated with many railroad engineering projects in the New York Albany territory, including various Hudson Division track improvements, the Castleton cut-off, and the West Side improvement.

Alfred D. Wolff

C. D. Williams, professor of civil engineering at the University of Florida, has accepted the position of chief structural engineer for Patchen & Zimmerman, of Augusta, Ga. Active in Society affairs, Professor Williams has served as Faculty Adviser to the Student Chapter at the University of Florida and as president of the Florida Section.

Peter A. Strobel and **Joseph Salzman,** consulting engineers, announce the removal of their offices to 50 West 40th Street, New York, N.Y.

Russell C. Brinker, professor of civil engineering at Virginia Polytechnic Institute, has been made head of the civil engineering department there.

Gannett, Fleming, Corddry & Carpenter, consulting firm of Harrisburg, Pa., has purchased the professional engineering business of the late **Charles Haydock,** of Philadelphia.

Curt A. Matvas, formerly junior civil engineer for the State Division of Highways, at Sacramento, Calif., has been transferred to the District V office in San Luis Obispo.

Jorge J. Jimenez, until recently Commissioner of the Interior Department of the Interior, at San Juan, Puerto Rico, has established a consulting engineering office in Santurce. For the past 18 years Mr. Jimenez has been engaged by various municipal, insular, and federal agencies in Puerto Rico.

James Conforti, Jr. has been elected treasurer of the William L. Crow Construction Company, New York, N.Y. He joined the company in 1949, and has served as assistant estimator, chief estimator and chief engineer. Mr. Conforti served as a lieutenant commander with the U.S. Navy during the last war, and has been admitted to the Bar in Washington, D.C.

George F. Tongue, maintenance and construction superintendent for the Dallas Railway & Terminal Co., at Dallas, Tex., has been named chief engineer there.

Charles L. Miller is now assistant to the district engineer in charge of southern operations of the Rochester, N.Y., engineering firm of Michael Baker, Jr., Inc. His headquarters are in Jackson, Miss.

Charles B. Spencer, vice president for Spencer, White & Prentis, Inc., of New York, N.Y., has been named chairman of the alumni special gifts committee for civil engineers in the Columbia University Engineering Center Development Fund. Members of the committee are **Robert A. W. Carleton,** president of the Carleton Co., Inc.; **Richard E. Dougherty,** Past President of ASCE and consulting engineer; **Prof. Jewell M. Garrelts,** of Columbia University; **Richard Hazen,** consulting engineer; **William Heyman,** treasurer for Lenart Constructors, Inc.; **Frederick G. Merckel,** of the Wallace & Tiernan Co., Inc.; **Gilbert M. Serber,** president of the Stock Construction Corp.; **Ray N. Spooner,** treasurer for Allen N. Spooner & Sons, Inc.; and **David B. Steinman,** consultant.

John P. H. Perry, former vice president of the Turner Construction Company, New York City, has been appointed Deputy for Installations to the Assistant Secretary of the Air Force. As Deputy for Installations, he will be responsible for expediting the development of the USAF air base structure in the United States and overseas. Mr. Perry is a former Director of ASCE and former president of the Metropolitan Section of the Society, United Engineering Trustees, Inc., and Engineers Council for Professional Development.

Nicholas V. Feodoroff, associate professor of civil engineering at Manhattan College, has been accepted as a Fellow in the New York Academy of Sciences. Professor Feodoroff received the honor "in recognition of his outstanding scientific achievements." The Academy, organized in 1817, is the fourth oldest scientific society in the United States. Professor Feodoroff, who has been on the faculty of Manhattan College since 1941, holds a diploma from Svobodyna University in Sofia, Bulgaria, and B.S. and C.E. degrees from Columbia University.

N. V. Feodoroff

Lt. Col. Eugene P. Fortson, Jr. (right), commanding officer of the 434th Engineer Construction Battalion is awarded the Bronze Star by Brig. Gen. Henry K. Kellogg, commanding general of the 409th Engineer Brigade. Colonel Fortson received the award for meritorious service in connection with the repair of the Han River railroad bridge at Tanyang, Korea, described in his article in this issue. Lt. William L. Lindsey, aide-de-camp to General Kellogg, is at left.

Clay Bedford, formerly Deputy Defense Production Administrator, has been named special assistant and production expediter for Secretary of Defense **Robert A. Lovett,** with headquarters in Washington, D.C.

Edward S. Bres, major general, Department of the Army, in Washington, D.C., was recently presented with honorary membership in the Louisiana Engineering Society.

John L. Nikkel, associate civil engineer in the Gulf Coast division office of the Humble Oil and Refining Co., at Houston, Tex., has been transferred to the organization's district office in Los Angeles. **Dudley J. Lewis,** district civil engineer for the oil company at Monroe City, Tex., has been named supervising engineer at Houston. **Robert Hindman** is now with the gas construction division in Houston.

Richard Hazen, consulting engineer, and **Alfred W. Sawyer,** former associate in Malcolm Pirnie Engineers, announce the formation of a partnership for the practice of engineering, with offices at 110 East 42nd Street, New York City. They will specialize in investigations, design, supervision of construction and operation, water supply, purification, distribution, sewage works, and industrial waste disposal.

Alfred B. Heiser, who recently retired as chief draftsman for the American Can Co., New York, N.Y., has established a consulting practice in New York City, specializing in industrial building work.

Joseph E. Patten has resigned as civil engineer for the U.S. Bureau of Reclamation, at Chico, Calif., to accept a position as field engineer for a private construction firm in San Francisco.

E. C. H. Bantel, professor emeritus of civil engineering, University of Texas, recently received a scroll of appreciation and a leather lounge chair from the ASCE Student Chapter there. Professor Bantel retired in the fall after a 50-year teaching career.

Harold B. Schultz, previously chief of the bridge design branch of the Alaska Road Commission, at Juneau, has been promoted to chief of the engineering division there.

John S. Flockhart, head of the Bureau of Sanitation, at Newark, N.J., is now city engineer.

Anthony Benish, formerly assistant professor of civil engineering at the University of Texas, has accepted a position with the Sun-Ray Oil Co., at Tulsa, Okla.

Ernest J. Vlad, partner in the consulting structural engineering firm of Frank J. Kornacker & Associates, of Chicago, Ill., has been appointed a research engineer in the structural department at the Armour Research Foundation of the Illinois Institute of Technology.

W. Kirk Pipkin, until recently a designer in the bridge department at Sacramento, Calif., has become bridge designer for the Texas Highway Department, at San Antonio.

Clifford V. Eckhardt, topographic engineer for the U.S. Geological Survey, at Sacramento, Calif., is now heading a U.S.G.S. project revising maps covering 24 quadrangles in Marysville, Calif. **Winfield Eldridge, Jr.** is assistant on the project.

Julian Hinds has retired as general manager and chief engineer of the Metropolitan Water District of Southern California, at Los Angeles, after an engineering career of 42 years. Mr. Hinds was commended recently for his "long distinguished public service and particularly for his valued contributions in furnishing Southern California with its vital supply of Colorado River water." He is a former Director of ASCE. Mr. Hinds is succeeded by **Robert B. Diemer,** since 1950 assistant general manager and chief engineer of the district at Los Angeles. Mr. Diemer has been a member of the engineering staff of the Metropolitan Water District for the past 22 years.

Julian Hinds

Robert B. Diemer

Albert L. Hambrecht, assistant engineer for the State Highway Commission, at Madison, Wis., is now engineer in charge of secondary roads for Wisconsin County.

G. H. Herrold, previously director of city planning for the City of St. Paul, Minn., has been appointed to the newly created position of city planning and zoning consultant.

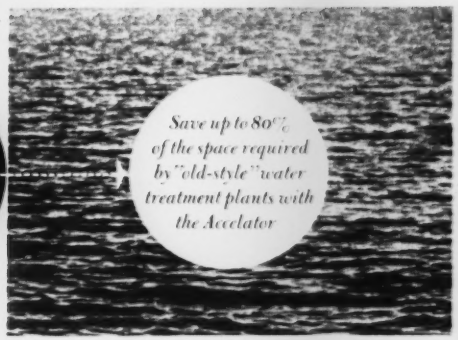
Byram W. Steele has retired as special assistant for civil works in the Office of the Chief of Engineers, Washington, D.C. He has served with the Army Engineers for more than 14 years and prior to his connection with the Corps of Engineers was for 16 years with the Bureau of Reclamation.

Harrison V. Pittman, for the past five years staff engineer on the advisory staff of the district engineer at the Little Rock, Ark., District of the Corps of Engineers, has retired after 44 years of government service. Mr. Pittman's service with the Corps of Engineers has been in the St. Louis, Kansas City, Cincinnati, Louisville, Memphis, Conchas, and Little Rock districts, engaged on lay out, inspection, and supervision of flood control structures.

Harrison V. Pittman

RUNNING OUT OF GROUND?

Accelator----



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RECENT BOOKS

Advanced Fluid Dynamics and Fluid Machinery

An extension of R. C. Binder's "Fluid Mechanics," this book bridges the gap between introductory and advanced works on the subject. "Part I, entitled "Fluid Dynamics," covers one-dimensional compressible flow, flow with friction, and heat transfer, and boundary layer flow. "Part II, "Fluid Machinery," is concerned with common machines and gives illustrations or applications of material previously studied. The third and last part, "Fluid Dynamics," deals with somewhat more complicated flows than those considered in Part I. Selected references and problems follow most chapters. (Prentice-Hall, New York, 1951, 426 pp, $8.)

Advances in Applied Mechanics, Vol. II.

The second volume in a series, this book surveys the present state of research work in various fields of applied mechanics. Edited by R. von Mises and T. von Karman, it consists of papers on the following topics: "Statistical theory of isotropic turbulence, laminar boundary layer in compressible flow, the bending of curved tubes, recent developments in inverse and semi-inverse methods in the mechanics of continua, and the theory of filtration of liquids in porous media. (Academic Press, Inc., 125 East 23rd St., New York, 1951, 233 pp., $6.50.)

These Men Saved $5,192.31 Today!

It is estimated that the cost of a ground survey on a large flood control project would have been over $3,000,000 and would have taken over 10 years. An Abrams Aerial Survey cut costs 90% — resulted in savings averaging over $5,000 a day. Time saved on the project was eight years.

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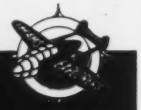

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Piping Stress Calculations Simplified

Exact solutions are provided by S. W. Spielvogel, for a large number of typical problems in the calculation of pipe stress under changing conditions of temperature. The solutions are presented in arithmetical form, and the mathematical theory involved is discussed. The book is intended to assist the designer of piping layouts. Some 30 extra pages of data tables have been added in the current edition. (S. W. Spielvogel, Lake Success, N. Y., 1951, 114 pages, $4.50.)

(A) Reference Handbook for Construction Engineers, Architects, Builders, Superintendents of Construction, and Building Construction Foremen

This handbook, by H. G. Richey, is designed for persons engaged in, or supervising, construction in the field. The contents have been arranged for ready reference as the information is presented in concise form. Subjects covered include foundations, construction materials, concrete construction, structural metal work, wood construction, mechanical and electrical equipment, fireproofing, waterproofing, laying out, etc. A glossary of engineering, architectural and trade terms is appended. (H. G. Richey, 1328 North Random St., New Orleans La., 1951, paged in sections, $10.)

Soil Mechanics, Foundations, and Earth Structures

Introductory without being elementary, this text by G. P. Tschebotarioff, covers theories of soil mechanics and the related design and construction practices of soil and foundation engineering. Emphasis is placed on experimental data and field observations illustrated by examples of both successful and unsuccessful structures. The book is intended for use at undergraduate and graduate levels and as a general reference. Special topics include the triaxial "cell" tests, allied geotechnical sciences (geology and soil physics), and soil engineering problems in permafrost regions. Extensive references are included to facilitate further study. (McGraw-Hill Book Co., New York, Toronto, London, 1951, 655 pages, $6.50.)

Einfuhrung in Wasserbau und Grundbau

An introduction to hydraulic engineering and foundation work, by T. Schiffmann, covering briefly the principles of water measurement, meteorology, hydrography, and ice and snow effects. The main part of the book is devoted to practical considerations of river regulation, irrigation and drainage methods, dams, canals, water power installations, sewerage, and harbor work. The final section deals with soil mechanics and foundations. (Springer-Verlag, Vienna, 1950, 445 pages, $11.50, *D.M.* 48, £4.2s.)

Engineering Graphics

This text, by J. T. Rule and E. F. Watts, presents the study of engineering drawing in a broader manner than usual. Emphasis is placed on the use of graphical methods for the analysis of engineering problems. Methods of construction of conic sections, roulettes and spirals, graphical scales, empirical and periodic curves, and projective constructions are considered with simple applications to numerical problems. The latter part of the book is devoted to the customary elements of machine drawing which underlie normal drafting room practice. (McGraw-Hill Book Co., New York, Toronto, London, 1951, 298 pages, $3.75.)

Strength of Materials

A textbook by Glen N. Cox, Frank J. Germano, and John H. Bateman, which emphasizes the topics that the authors have found students have difficulty in assimilating. It is intended for a first course in strength of materials and covers the structural elements, stress conditions, and analytical methods commonly included in such texts. Tables of elements of structural sections are appended, and over 500 problems of graded difficulty accompany the text. (Pitman Publishing Corp., New York, Toronto, London, 1951, 408 pages, $5.50.)

Architectural Graphic Standards

Designed to give architects, builders, draftsmen, civil engineers, and others interested in building the standards, facts and data needed to deal with every type and phase of building. The fourth edition, by C. G. Ramsey and H. R. Sleeper, is 80 percent larger, contains 368 new plates, 151 revised plates, and an extensive index with over 11,000 references. Data are included on all materials, fixtures, fittings, devices, equipment, accessories, utensils, furnishings, apparatus, machinery, supplies, and structural material. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1951. 614 pp. $10.)

Business and Professional Speech

A detailed treatment, by L. Crocker, of the basic aspects of speaking before an audience or group, covering grammar, selection of material, presentation of ideas, etc. Part II presents examples of common types of business and professional speeches. Appended are a bibliography and a section on suggestions to teachers. (Ronald Press Co., New York, 1951. 464 pages, $4.)

Corrosion Guide

The major part of this practical reference work, by E. Rabald, is composed of tables showing the interaction phenomena between more than 40 important construction materials (metallic and nonmetallic) and some 250 corrosive agents. The object is to provide the chemist or engineer with readily usable information in the choice of materials for laboratory or industrial processes. Corrosion fundamentals are discussed in an introductory section, and a table of the physical properties of the materials involved is provided. A bibliography lists important books and periodicals. (Elsevier Publishing Co., New York, Amsterdam, London, Brussels, 1951. 629 pages, $12.50.)

(An) Elementary Test in Hydraulics and Fluid Mechanics

Beginning with hydrostatics and the fundamentals of fluid flow, R. W. Powell continues with analysis of orifices, tubes, nozzles and weirs. Pipe flow is dealt with in two chapters and open channel flow in one. Further effects of viscosity, surface tension, and compressibility are discussed, and the use of hydraulic models is explained. Various data tables and certain specialized treatments are appended. (The Macmillan Co., New York, 1951. 316 pages, $4.75.)

Engineering Formulas

Molesworth's *Handbook of Engineering Formulae* has been made available in its thirty fourth edition after a complete revision. First produced by Sir Guildford L. Molesworth in 1862, this notable reference work has kept in step with engineering progress. The 1951 edition contains almost 1,700 pages of compact tabular matter and design formulas, aimed to serve civil, mechanical and electrical engineers, with the aid of a topical index of about 3,700 items. (Macmillan Co., New York, N.Y., 1951. $6.50.)

Thermodynamics

The opening chapter of this small book, by Alfred W. Porter, gives a historical account of the laws and other basic aspects of thermodynamics. The remaining four chapters present the text material under the following headings: Reversible changes; miscellaneous applications; irreversible operations; and equilibrium. (John Wiley and Sons, Inc., New York, 1951. 124 pages. $1.50.)

Bestimmungen des Deutschen Ausschusses für Stahlbeton mit Normen für Bindemittel und Deckensteine

A compilation of German specifications and standards in the field of reinforced concrete covering materials, test methods, structural elements, and construction details. There is an extensive index. (Wilhelm Ernst und Sohn, Berlin, 1951. 226 pages, D.M. 6.50.)

Industrial Wastes

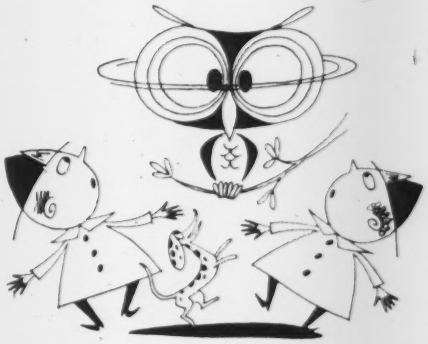
A comprehensive survey, by C. H. Lipsett, of the field of important industrial wastes including their economic function and utilization in the industrial field. The discussion covers origins, collection methods, marketing procedures, recovery processes, etc. The wide range of subject matter includes plastics, chemicals, metals, textiles, rubber, paper, leather, wood, glass, and organic and agricultural wastes. (Atlas Publishing Co., 425 West 23th St., New York, 1951. 317 pages, $5.)

(The) Making, Shaping and Treating of Steel

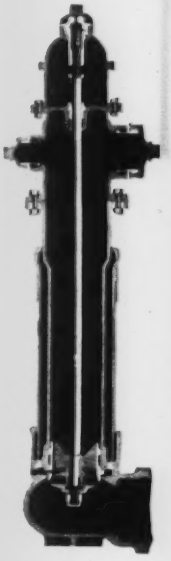
Thoroughly revised, and in large part rewritten by J. M. Camp and C. B. Francis, this standard reference work is now the result of the cooperative efforts of a large group of the technical and research personnel of the United States Steel Co. The information contained is a compilation of past and present practices in the iron and steel industry as summarized by numerous specialists and as based on their practical experience. In addition to the extensive coverage of the processes named in the title, the work covers fundamental chemical and physical principles, refractories and fuels, fluxes and slags, cast iron, sponge and wrought iron, special steels, and mechanical testing methods. The detailed 150 page index provides rapid reference to the contents. (Apply to Treasurer, United States Steel Co., 525 William Penn Place, Pittsburgh, Pa., 1951. 1,586 pages, $7.50.)

[Readers interested in "Einflusse auf Beton und Stahlbeton," reviewed on page 80 of CIVIL ENGINEERING for October 1951, may be interested in knowing that an American edition is available: "Influences on Concrete," translated by F. Morgenroth. (Frederick Ungar Publishing Co., 105 East 24th Street, New York, N.Y., 1951. $7.50.)]

Head turns all the way around



Nozzle direction may be changed easily and at any time by simply loosening the bolts in the swivel flange and turning the head . . . The number and size of nozzle outlets can be changed by replacing the head, and without shutting off the water.



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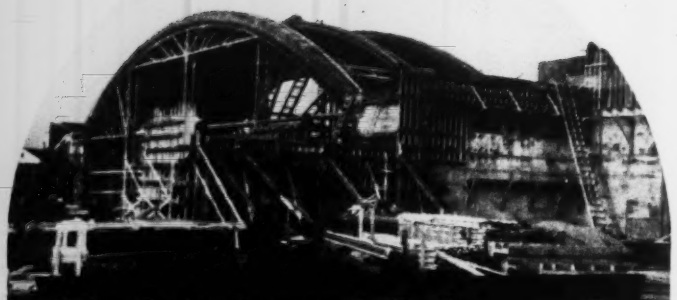
Concrete arch hangar under construction at St. Hubert, P. Q., showing use of prefabricated falsework. Covering will be concrete shell, supported by reinforced concrete arches



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New Publications

Waste Disposal. The proceedings of the Sixth Industrial Waste Conference held at Purdue University last year are now available at $1.25 a copy. The 506-page bulletin, including the index for all previous proceedings, may be obtained from Dean A. A. Potter, Executive Building, Purdue University, Lafayette, Ind. Checks should be made out to Purdue University. Those attending the conference will receive copies without charge.

Improved Nailing. Laboratory tests confirming data on structural improvements to be attained by use of improved helically or annularly grooved nails for certain types of fastening are detailed in a recent bulletin (No. 76) of the Virginia Polytechnic Institute. The publication, which is entitled *Improved Nails for Building Construction*, by E. George Stern, Assoc. M. ASCE, sells for 25 cents upon application to the Institute at Blacksburg, Va.

Sewerage Legislation. To aid individuals and communities in studying and solving their local sanitation problems, the California State Water Pollution Control Board has issued a booklet entitled *Digest of Sewerage Enabling Acts of the State of California*. Included are salient features of acts relating to the formation of basic organizations for the construction, maintenance, operation and financing of sewerage facilities. Single copies are available from the State Board (at Sacramento, Calif.) without charge. Additional copies may be purchased from the Documents Section, State Printing Division, 11th and O streets, Sacramento 14, Calif., at a cost of 50 cents a copy plus the 3 per cent California sales tax.

Pollution Control. Accomplishments of eight states in their combined effort to combat stream pollution and preserve water resources in the Ohio River Valley are summarized in the third annual report of the Ohio River Valley Water Sanitation Commission. Copies of the report may be obtained from the Commission at 414 Walnut Street, Cincinnati 2, Ohio.

Cement and Concrete. A compilation of facts about the history, manufacture, and uses of portland cement and concrete comprises *The Cement and Concrete Reference Book* released by the Portland Cement Association. Copies of the 111-page illustrated bulletin are available from the Association, 33 W. Grand Avenue, Chicago 10, Ill.

Hydraulic Research. All Waterways Experiment Station reports of investigations in hydraulics, soil mechanics, flexible pavement, and concrete research are covered in a 1951 edition of the *List of Publications of the Waterways Experiment Station*. Also included are reports of all model work performed by other Corps of Engineers hydraulic laboratories. The list is available on request and without charge from the Waterways Experiment Station, Vicksburg, Miss.

Geological Survey. The geology of Lafayette County, Mississippi, is studied by James S. Attaya in Bulletin 71 of the Mississippi State Geological Survey. The study is said to solve geological problems that have been a controversial issue among students of stratigraphy since 1860. Inquiries should be addressed to the Mississippi Geological Survey, University, Miss.

Hydraulic Research. To provide a guide to the current and completed projects conducted by various hydraulic and hydrological laboratories in the United States and Canada, the National Bureau of Standards has issued a 190-page publication entitled *Hydraulic Research in the United States*. Copies, priced at $1.25 each, may be ordered from the Government Printing Office, Washington 25, D.C.

Radiological Health. Reports presented at the Fourth National Public Health Engineering Conference, 1951, have been issued by the College of Engineering of the University of Florida as Bulletin Series No. 48 under the title *Radiological Health and Civil Defense*. Copies of this illustrated booklet, one in a series of monthly publications, may be obtained from the Director, Florida Engineering and Industrial Experiment Station, Gainesville, Fla.

Flood Control. Model investigations of the control structure for the Morganza Floodway conducted by the Waterways Experiment Station are described in Technical Memorandum No. 2-426 recently announced by the Army Corps of Engineers. The investigations included examination of the over-all performance of the structure, with particular attention to discharge coefficients, flow at the abutments and energy dissipation. Copies may be purchased from the Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss., at $1 each.

Building Research, Canada. A progress report on building research in Canada has been issued by the Division of Building Research of the National Research Council of Canada as Volume I, No. 1 in a projected series. Founded in 1947, the Division is devoting increasing attention to the effect of the Canadian climate on building research, especially as it affects insulation requirements. Findings in the field and numerous other projects of the Division of Building Research are outlined in the bulletin, which is obtainable from the headquarters of the Council at Ottawa, Canada. The price is $1.

Hydrologic Frequency Analysis. As a useful tool for the hydrologic design of hydraulic structures, a formula with curves based on many existing methods of hydraulic frequency analysis is described in a paper entitled "A General Formula for Hydrologic Frequency," by Dr. Ven Te Chow, Assoc. M. ASCE. Reprints of the paper, which appeared in the *Transactions* of the American Physical Union (Vol. 32, No. 2, April 1951) are available from Dr. Chow, 317 Civil Engineering Hall, University of Illinois, Urbana, Ill.

Parking Survey. Preliminary data on the Cleveland Downtown Parking Survey, which has been in progress since the summer of 1948, are reported by the Cleveland City Planning Commission in an illustrated brochure entitled *Our Downtown Parking Headache and How We Can Cure It*. The publication, which includes end results and concrete recommendations for remedial action, may be obtained from the Cleveland City Planning Commission, Cleveland, Ohio. A more complete analysis and summary of the data will be made available in a later Technical Report.

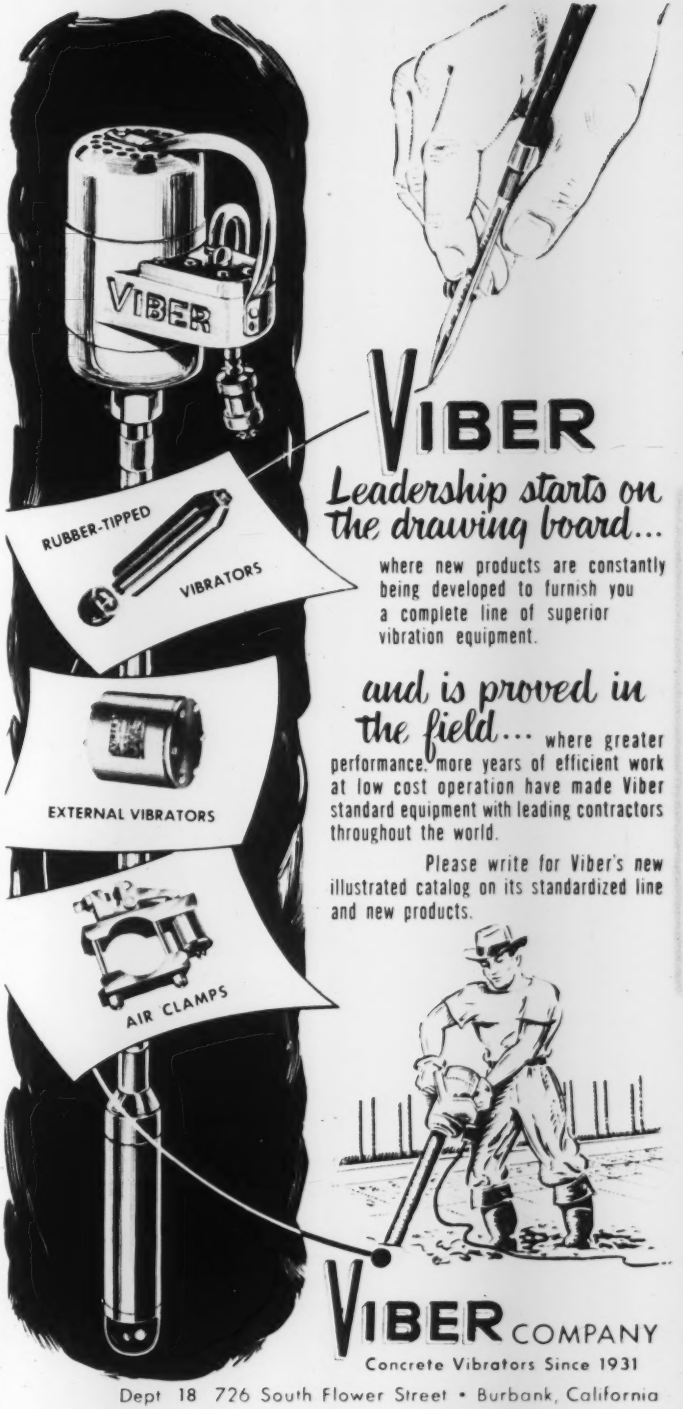
Highway Research. Use of volcanic ash and laterite soils in highway construction is discussed in Bulletin 44 of the Highway Research Board. Included are a paper by K. B. Hirashima, testing engineer for the Territorial Highway Department, Hawaii, on "Highway Construction Problems Involving Plastic Volcanic Ash," and one by Hans F. Winterkorn and E. C. Chandrasekharan, of the Winterkorn Road Research Institute, Princeton, N. J. Copies may be purchased at 60 cents each from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D. C.

Construction Industry. Training afforded young engineers in the construction industry at Massachusetts Institute of Technology is described in a recent M. I. T. brochure entitled *Education in Building Engineering and Construction*. Copies may be obtained from Walter C. Voss, head of the Department of Building Engineering and Construction, Massachusetts Institute of Technology, Cambridge 39, Mass.

Soil Compaction. Results of field penetration tests to determine the relationship between area, contact pressure, and depth and rate of penetration of a model foot of a sheepsfoot roller are made available by the Corps of Engineers in Technical Memorandum No. 3-333 of the Waterways Experiment Station. Copies, priced at $1 each, may be obtained from the Station at Vicksburg, Miss.

Surveying Instruments. Availability of its 52nd edition of the *Manual of Surveying Instruments* is announced by W. & L. E. Gurley, of Troy, N. Y., veteran manufacturer of engineering and surveying instruments. The 152 page illustrated publication combines specific details of adjustment of Gurley instruments with related factual information and practical instruction data on the care and handling of all transits, levels, alidades, compasses, and accessory surveying equipment. Copies are available to engineers and surveyors at $1 each.

(Continued on page 86)



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Men Available

Civil Engineer Jun. M. ASCE, 27, single. B.C.E. June 1950, approximately 2 years experience in supervision of construction and survey work, desires responsible position in construction field; prefers overseas employment. C-712

Assistant Professor, Assoc. M. ASCE. B.S. in C.E., B.S. in C.E., M.S. this June, 41, married, married, 18 years varied experience including engineering work and teaching. Available in June. Location preferred: western United States. C-713 [2] A-1 San Francisco

Civil Engineer, Jun. M. ASCE. B.S. in C.E., '50, over 1 year highway and bridge experience both design and field. Desires position connected with construction work in the East, preferably central New York State, with reliable company. C-714

Project Engineer, Assoc. M. ASCE, registered, '30, C.E. degree, 20 years experience in structural design and construction of industrial buildings, factories, heavy engineering, and bridge structures including responsible charge of field and office organizing, estimating, specifications and client relations. Desires permanent connection with firm in New York metropolitan area. C-715

Civil Engineer, M. ASCE, registered, 47, experienced in structural design of powerhouses, dams, ports, industrial buildings, canal structures and locks. Has made complete river basin surveys, structural plans, specifications and engineering reports. 21 years United States and foreign experience. Available immediately. C-716

Civil Engineer, Jun. M. ASCE, well acquainted with office and accounting procedures, now specializing in civil engineering with substantial past field experience, desires permanent position in Washington, D.C., or southeast Florida area with medium sized private firm, not necessarily in the construction industry. C-717

Civil Engineer, M. ASCE, registered N.Y., 49, married, over 25 years experience in design and construction of large industrial plants and commercial buildings, and in aggregates production and transit mixed concrete. Extensive knowledge of specifications, contracts and purchasing. C-718

Positions Available

Assistant or Associate Professor of Civil Engineering, '51-'50, with advanced degree and some teaching experience. Should be qualified in field of soil mechanics and highway engineering. Salary about $4,000-$4,200 a year. Location New England. A-6228-3

Structural Designers, C.E. degree with 2 to 10 years experience on structural design work including new projects (buildings, roadways, paving, etc.). Combination of field and office necessary. Must be able to submit renderings, etc. Salary $4,800-$7,000 a year. Location New York, N.Y. A-6230-6

Designers with some experience in structural design, sanitary, water supply, architecture, plumbing and heating, and electrical work for engineering organization. Salary plus bonus. Location: Illinois. A-6240

Instructor in engineering drawing, sound, mechanical or civil graduate to teach freshmen engineering drawing and descriptive geometry, machine drawing and civil engineering drawing. Minimum starting salary $4,000 for 9 months or $4,000 for 12 months on alternate summers. This includes a minimum of 1 month vacation periods. Location: South. A-6275

Project Engineer, civil and architectural with experience in office and institutional type buildings. Considerable traveling. Salary $7,200 a year. Headquarters: Washington, D.C. A-6439

Engineers, a) Resident Engineer, civil graduate with general construction experience preferably on airfields, and the development of airbases. Salary to $6,600 a year. Location: North Africa. b) Resident Engineer, civil graduate with duties similar to above. Salary to $8,400 a year. Location: Newfoundland. A-6495

Architect with considerable experience, to be completely responsible for the coordination of hospital project. Salary open. Location: East. A-6436

Engineers, a) Hydraulic and Structural Engineer, civil graduate with at least 8 years hydroelectric experience, to design and supervise design of dams, canals, penstocks and associated hydraulic works. Design foundations for various types of structures including buildings. Make extensive and important studies involving various hydraulic problems in connection with power system development, prepare estimates and reports, direct preparation of plans and supervise construction operation. Salary $6,300-$7,200 a year. b) Assistant Engineer, hydraulic and structural, civil graduate with at least 4 years hydroelectric experience to lay out and prepare plans, make investigations in connection with various hydraulic and structural problems for systems development and expansion. To take charge of general supervision of a survey party or a group of draftsmen. Make and check estimates of quantity and cost. Prepare reports. Salary $5,400-$6,300 a year. Location: New England. A-6445

Teaching Personnel, 30-38, with advanced degree and preferably some research experience to teach civil engineering. Rank and salary dependent upon experience. Location: upstate New York. A-6463

Construction Engineers to supervise engineering and coordinate craft work on chemical project. Salary open. Location: South Carolina. A-6474

Instructor or Assistant Professor to teach surveying and highways and mechanics or hydraulics. Master's degree preferred. Salary to start $3,800-$4,400 a year. Position starts March 1952. Location: West. A-6486

Sales Engineer, preferably mechanical or civil graduate under 40, for company selling pneumatic conveying equipment, automatic scales, storage silos and air compressors to industrial, chemical and cement using industries. Salary $4,000-$5,000 a year depending on experience, plus share in profits on completion of training about 1 year. Territories: western Pennsylvania, Ohio and West Virginia. A-6487

Resident Engineer with considerable experience in highway design and construction to represent contractor. About 2-3 years work. Some knowledge of Spanish desirable. May take family. Salary $10,200 a year plus $250 a month living allowance. Location: Colombia, South America. A-6508

Structural Engineer, senior, civil, 30-40, with considerable experience at substantial levels in design on industrial buildings in general engineering department for an essential packing plant company. Requires unusual and high grade engineer. Salary open. Location: Chicago. R-8360

Structural Designer, civil, with 2 years' experience in structural design work for structural designer and some field work for consulting engineer. Company may negotiate the fee. Salary $8,000 a year. Location: western Chicago. R-8518

Commissioner of Public Works, preferably civil graduate. Must be good administrator and have at least 10 to 15 years experience in general city management. Salary $8,000 a year. Location: New York State. A-6662

Structural Designer, Civil, 5 years experience plus structural design work. To do structural designer work for architectural engineering firm. Company will pay the fee. Salary $6,240 a year. Location: Chicago. R-8529

Recent Graduates—Civil or Mechanical Engineers. Will consider recent graduates or men with some experience. Some knowledge of heavy steel construction helpful. The duties will be to design or do drafting on steel plate construction work which is custom built; may also get some field shop experience on following up projects. Company will pay fee. Housing available for single people. Salary $4,000-$7,800 a year. Location: south side of Chicago. R-8555

Positions Announced

Municipal Civil Service Commission, New York. Announcement of an examination for Junior Civil Engineers, to fill positions paying yearly salaries of $3,550, is made by the City of New York Municipal Civil Service Commission. To qualify, applicants must be college graduates. Applications must be obtained from and filed at the Application Section, 96 Duane Street, New York, N. Y.

State of Maryland. Immediate openings in the fields of highway and bridge engineering are available through the Department of State Employment and Registration in Baltimore, Md. Typical of positions available is that of Junior Assistant Highway Engineer II in the Road Design Division of the Maryland State Roads Commission, at a beginning salary of $3,060 per year, increasing in five years to $4,575. Further information and application forms may be obtained from the State Employment Commissioners Office, 31 Light Street, Baltimore 2, Md.

[*Editor's Note:* Applicants for engineering positions abroad with the Department of the Army (announced on page 133 of the January issue) are requested to apply to the Engineer District nearest their residence, and not to the New York District office as announced in the January issue. Engineers in the New York area will apply to the New York District.]

Non-ASCE Meetings

American Concrete Institute. Economy in design and construction and good concreting practice will be discussed at the American Concrete Institute convention at the Netherland Plaza Hotel, Cincinnati, Ohio, February 26-28.

American Concrete Pressure Pipe Association. The third annual meeting of the American Concrete Pressure Pipe Association will be held at the Drake Hotel, in Chicago, Ill., on February 27 and 28.

American Society for Testing Materials. The ASTM Spring Meeting and Committee Week will be held at the Hotel Statler in Cleveland, Ohio, March 3-7.

Associated General Contractors of America. Headquarters for the 43rd Annual Convention of the Associated General Contractors of America, Inc., will be the Hotel Statler in Detroit, Mich. The dates are February 25 through 28.

Illinois Conference on Highway Engineering. The 38th annual Illinois Conference on Highway Engineering is to take place at the University of Illinois, in Urbana, February 19-21.

Second Midwestern Conference on Fluid Mechanics. The Second Midwestern Conference on Fluid Mechanics will be held at Ohio State University, Columbus, March 17-19. Co-sponsors are the Graduate School of Ohio State University, the American Meteorological Society, the ASME, the Institute of Aeronautical Sciences, the American Physical Society, Fluid Dynamics Division, the AIChE Columbus Section, and the Columbus Section of ASCE. Further information may be obtained from the conference secretary, Prof. Geoffrey Keller, Department of Physics and Astronomy, Ohio State University, Columbus, Ohio.

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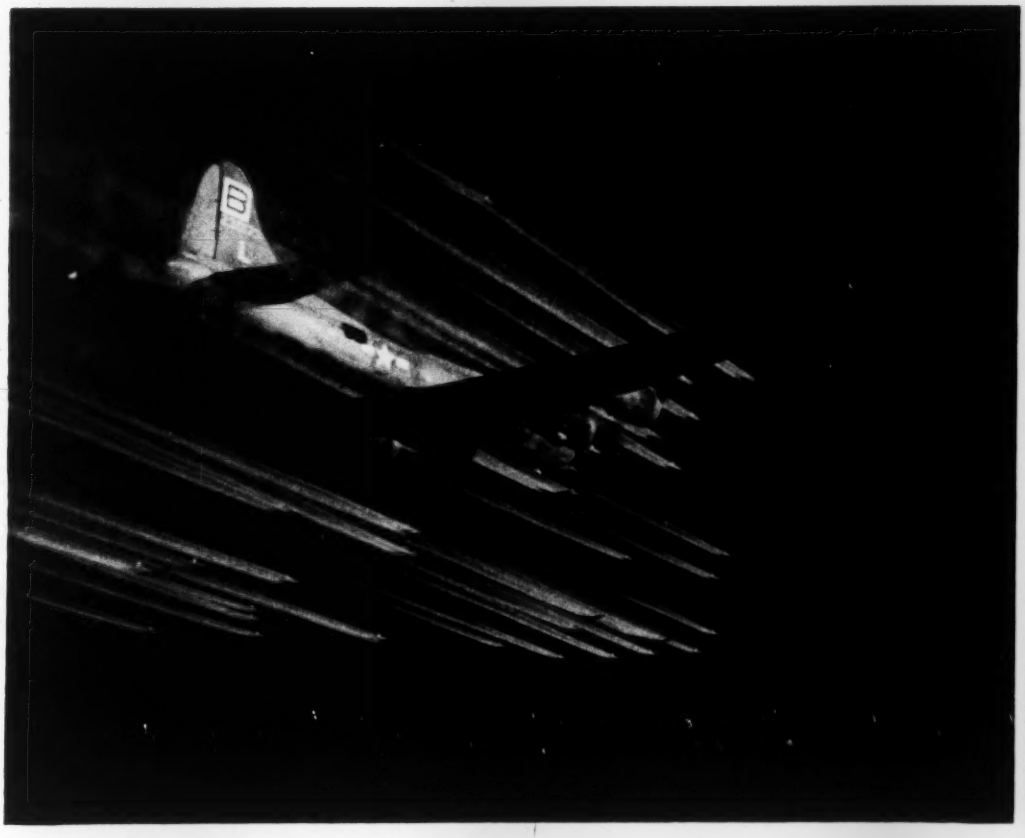

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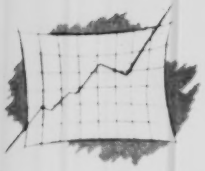

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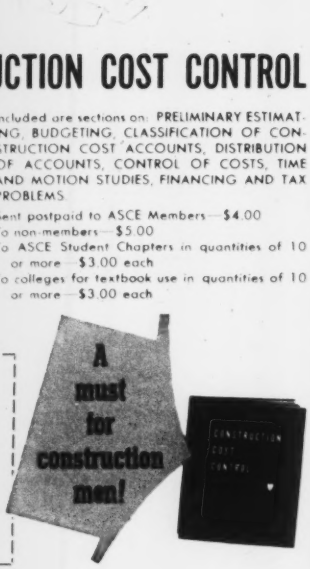

New Publications

(Continued from page 81)

Industrial Directory, Mexico. Availability of a second edition of the Mexican National Industrial Directory, sponsored by the Confederation of Industrial Manufacturers of Mexico, is announced. The only directory of Mexican industries, the new edition is published in two volumes and contains 5,000 pages—a tremendous increase over the 1,200 pages comprising the first edition. Cost of the directory is $20 f.o.b. Mexico City. The Rolland Publications Dept. CE, Plaza de la Republica 6, Mexico City, Mexico.

Housing Research. Results of many HHFA research projects, especially those focused on immediate emergency needs, are summarized in a new quarterly started by the Housing and Home Finance Agency. The new periodical entitled *Housing Research* replaces the *HHFA Technical Bulletin*. Inquiries should be addressed to the HHFA Office of the Administrator, Washington, D. C.

Highway Roster. The 1951 Roster of State Highway Officials and Engineers, issued each year by the American Road Builders' Association in collaboration with the state highway departments, may be obtained from the ARBA International Building, Washington 4, D. C. In handy pocket size, the 66 page booklet contains the names, titles, and addresses of highway department personnel of all states and the U. S. Bureau of Public Roads. Copies sell for $1 each.

Engineering Research. Fifteen years of research are highlighted in a recent 56 page annual report of the Armour Research Foundation of the Illinois Institute of Technology. Scientific progress on a wide variety of research projects and an increase of one-third in volume of investment by sponsors, totaling $6,225,301 for the fiscal year, are revealed in the report. The report notes an increased amount of international research, including projects in Latin America, Europe, and the Far East. A survey of South American construction materials has just been completed. Inquiries concerning the annual report should be addressed to the Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

Public Health. The California State Water Pollution Control Board, which has been designated state water pollution agency for the purposes of the Federal Water Pollution Control Act by the U. S. Public Health Service, announces the availability of several USPHS publications. These include *Water Pollution in the United States*, Water Pollution Series No. 1, 1951, for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 35 cents; *Great Basin Drainage Basin—A Cooperative State Federal Report on Water Pollution*, Water Pollution Series No. 4, 1951; and *California Drainage Basins—A Cooperative State Federal Report on Water Pollution*, Water Pollution Series No. 5, 1951. Inquiries concerning the two latter publications should be addressed to the California Water Pollution Control Board, Sacramento 14, Calif.

Defense Data. The inventory of Department of Defense technical information prepared by a special committee of the Research and Development Board is summarized in the December issue of *Science*. Prepared for the information of engineers and scientists working in the National Defense Program, the summary describes the technical information groups of the three military departments and the Research and Development Board, and similar services of other government agencies. A limited number of reprints of the summary may be obtained from the Special Committee on Technical Information, Research and Development Board, Washington 25, D. C.

Engineering Research. A complete guide to engineering college research, listing 5,200 research projects in 91 prominent American colleges and universities, has been issued by the Engineering College Research Council of the American Society for Engineering Education. The 250 page paper bound publication includes a complete index of research project subjects. It may be obtained from the Council, Room 7-204, 77 Massachusetts Avenue, Cambridge 39, Mass. The price is $2.25.

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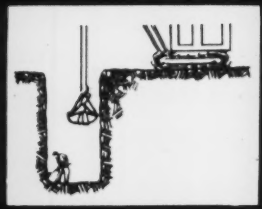

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Pollution Research. Availability of a new eight-page booklet, entitled *Research in Air and Water Pollution*, is announced by Vern W. Palen, Bureau of Public Information, New York University College of Engineering, New York 53, N.Y. The new publication describes the work and facilities of the Air and Water Pollution Research Section of the Research Division and is well illustrated with photos showing wind tunnel tests, balloon high-altitude experiments, the radioactive laboratory, air sampling, and health and safety techniques.

[Editor's Note: In a "New Publications" review of a book by T. Blench, M. ASCE, on *Hydraulics of Sediment Bearing Canals and Rivers*, in the November issue (page 90), the price was incorrectly listed at $4.75. The price is $5, and copies may be obtained from Professor Blench, University of Alberta, Edmonton, Alberta, Canada.]

Applications for Admission To ASCE, December 16, 1951—January 12, 1952

Applying for Member

GEORGE PERCIVAL BULLARD, Pottstown, Pa.
FRANK THOMAS COLLINS, San Gabriel, Calif.
JAMES GUY EERNISSE, Tacoma, Wash.
RALPH BARTLETT GILE, Schenectady, N.Y.
MAURICE RALPH HAMILL, Charleston, W. Va.
EDWARD SWAIN HOPE, Beirut, Lebanon
ERNEST JOSEPH JAMES, Baton Rouge, La.
CASIMIR IAN KRAY, Boston, Mass.
ELDRIDGE HIRST LOVELACE, St. Louis, Mo.
KARNAIL SINGH, Bombay, India
WILLIAM FORSTER SUMMERS, New York, N.Y.
ADOLFH GEORGE SUNDA, Alexandria, Va.
EDWARD THOMAS TELFORD, Sacramento, Calif.
ESTEBAN RAUL TORRIENTE Y NETHOT, Havana, Cuba
BENJAMIN JOSEPH WAGNER, San Francisco, Calif.
ALEXANDER RUSSELL YOUNG, Kansas City, Mo.

Applying for Associate Member

GERARD MAXIMUS ANGHIE, Colombo, Ceylon
GUNNAR BERTH, Caracas, Venezuela
DONALD COLGATE, Longmont, Colo.
GERALD N. COSTAIN, Cambridge, Mass.
GEORGE EDGAR CROUCH, Johnson City, Tenn.
DONALD DARROCH, Glasgow, Scotland
SAMUEL BENJAMIN GILL, Cleveland, Ohio
HAROLD WILLIAM HOLDAWAY, Sydney, N.S.W., Australia
PATRICK TERENCE LORDING, Oakland, Calif.
ALFRED WITHERS MANOR, Charlottesville, Va.
JOHN HANFORD MORGAN, Sulphur, La.
KENNETH PETER NORRIE, Spokane, Wash.
ROY BERNARD PETERSON, Detroit, Mich.
MYRON SHERMAN RAUDEBAUGH, Jr., Canton, Ohio
HARRY LOUIS TOOKER, Jr., Houston, Tex.
YOGESHWAR NATH ZUTSHI, Garhwal, U.P., India

Applying for Junior Member

DONALD ELGIN, San Francisco, Calif.
WALLACE ROBERT BENSON, Ft. Collins, Colo.
WILLIAM RODNEY BRIGGS, Victoria, Australia
WILLIAM HOWARD CAMERON, Parent, Que., Canada
JACK WILFRED CARNEY, Atlanta, Ga.
DON B. GALLAY, Chicago, Ill.
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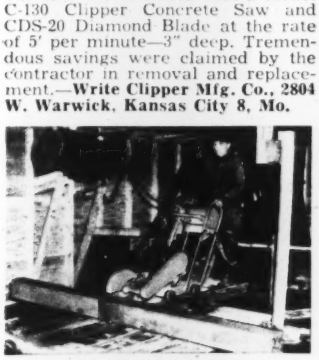
[Applications for Junior membership from ASCE Student Chapters are not listed.]

CONSTRUCTION EQUIPMENT NEWS

A Preview of Equipment That Will Help You On the Job

PATCHES—TRENCHES SAWED FOR FLOOR—STREET REPAIR — Saw concrete floors, walks or streets! Saw narrow slit trenches 1" wide for conduit or any width for utility lines. Eliminate jackhammer fractures beyond the straight, smooth sawed lines.—**Write Clipper Mfg. Co., 2804 W. Warwick, Kansas City 8, Mo.**

FLOORS, DRIVES, RUNWAYS EASILY CUT FOR REPAIRS—Rail tunnels, rail and pipe trenches, air lines and machinery bases were cut in dense concrete with a Model C-130 Clipper Concrete Saw and CDS-20 Diamond Blade at the rate of 5' per minute—3" deep. Tremendous savings were claimed by the contractor in removal and replacement.—**Write Clipper Mfg. Co., 2804 W. Warwick, Kansas City 8, Mo.**



TRACK SAW NOW CUTS LARGEST STONE, TRANSITE, TERRA COTTA — By placing C-15 Clipper Concrete Saw on tracks, a Cleveland contractor cut limestone veneer units from 15'x7"x15" quarry lengths. In addition to large, bulky shapes this model is efficient and dustless for inside patch and trench work.—**Write Clipper Mfg. Co., 2804 W. Warwick, Kansas City 8, Mo.**

CONTRACTION JOINTS NOW SAWED—Floors, walks, drives and runways now poured continuously (reduces bulkheading!) Then joints are sawed to eliminate hand forming and costly spalling.—**Clipper Mfg. Co., 2804 W. Warwick, Kansas City 8, Mo.**

STUDIES OF SAWED JOINTS PROVE VIRTUAL ELIMINATION OF SPALLING — Highway transverse joints sawed 2" deep are devoid of spalling after 1½ years in contrast to heavy spalling in a few weeks on formed joints, according to State tests.

Typical spalling after few weeks heavy traffic.

Sawed joints on same highway after 1½ years.

It's Done Easier, Faster, More Economical when you SAW BEFORE BREAKING with

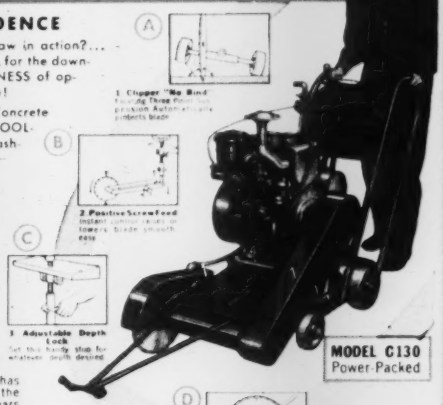
CLIPPER CONCRETE SAWS

CONCRETE EVIDENCE

Ever watch a Clipper Concrete Saw in action?... If not you've missed something... for the downright SPEED, EASE and SMOOTHNESS of operation is really something to see!

You'll recognize that Clipper Concrete Saws are designed for SIMPLE, FOOL-PROOF DUSTLESS performance. Dashboard controls — perfect balance — floating three point blade suspension* — and "job-rated" power plants... all combined for concrete and asphalt cutting far beyond anyones expectations.

*A pivoting front axle keeps the blade straight in the cut even on rough surfaces — stops binding — stops excessive blade costs.



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The outstanding policy of FREE TRIAL has been in effect since Clipper invented the World's First Masonry Saw many years ago! Clipper Concrete Saws are GUARANTEED to Provide — regardless of hardness ... the Fastest Cut ... at the Lowest Cost ... with the Greatest Ease ... Anytime ... Anywhere! You be the judge ... TRY A CLIPPER ON **FREE TRIAL!**

Experience Proves A Concrete Saw Must Have These Clipper Features

Clipper

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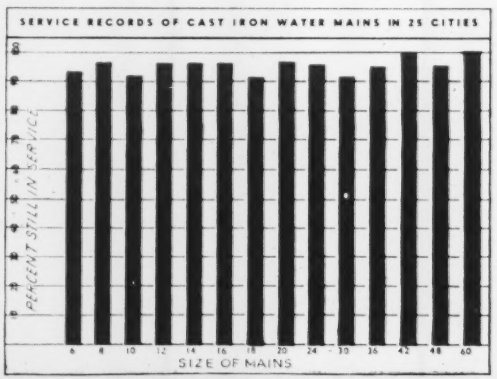
Gulf of Mexico
• Black dots represent original cast iron mains in service
* Red stars represent cast iron mains in service 100 years or more

AMERICA PROVES IT! The above map shows cities having some or all of their *original* cast iron water or gas mains still in service. The red stars indicate 34 cities having cast iron water or gas mains in service that were laid a century or more ago.

SURVEYS PROVE IT! A recent study directed by 3 Water Works Associations shows that 96% of all cast iron water mains, 6-inch and over, *ever laid*, in 25 representative cities, are still in service.



CAST IRON PIPE

of CAST IRON PIPE...

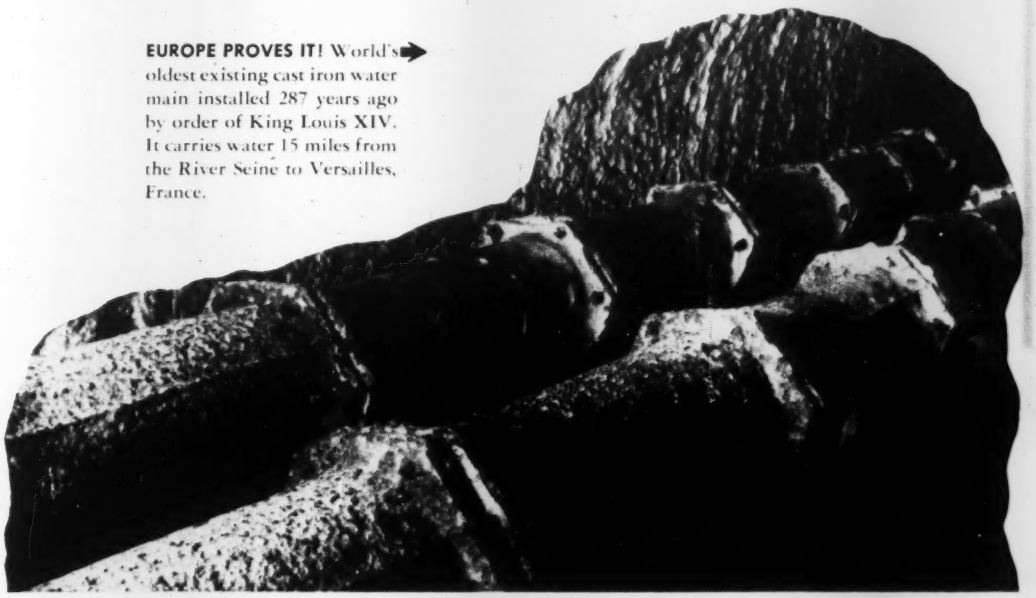
Europe proves it! The oldest cast iron water mains in the world, by authenticated records, supply the town and parks of Versailles, France. They were installed in 1664 and are still functioning after 287 years of service. Other cities in France, Germany and the British Isles have cast iron mains in service that are over 100 years old.

America proves it! Original cast iron mains are still serving 57 of America's largest cities. And 34 cities have either cast iron water or gas mains in service that were laid over 100 years ago (see map).

Surveys prove it! An exhaustive study, directed by a Joint Committee representing 3 Water Works Associations, shows that 96% of all cast iron water mains, 6-inch and over, *ever laid* in 25 representative cities, are still in service (see chart).

Yes, history proves beyond doubt that cast iron pipe has the stamina and the strength-factors that pipe must have to serve dependably under the paved streets of cities, towns and villages.

EUROPE PROVES IT! World's oldest existing cast iron water main installed 287 years ago by order of King Louis XIV. It carries water 15 miles from the River Seine to Versailles, France.



CAST IRON PIPE RESEARCH ASSOCIATION; THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

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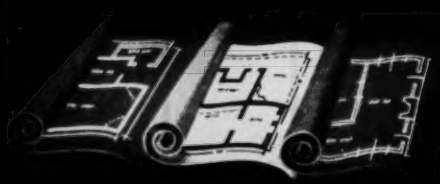

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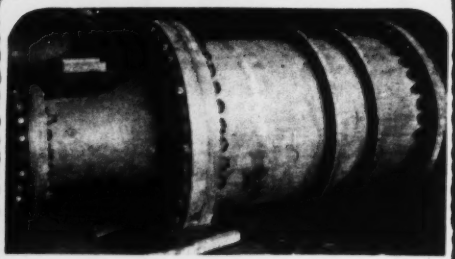

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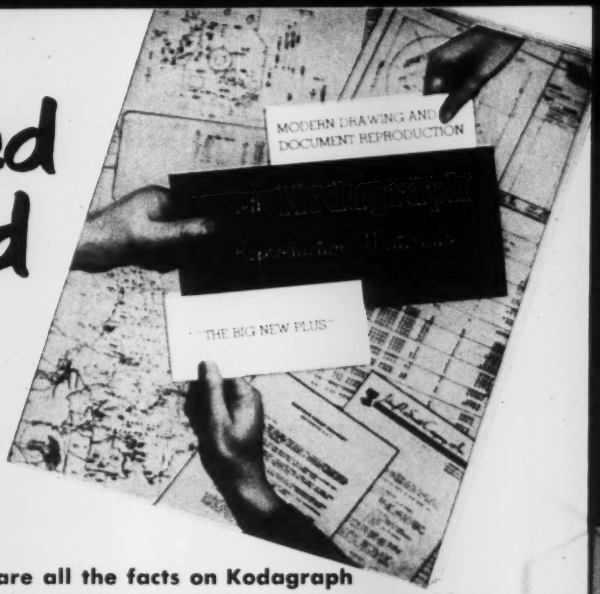

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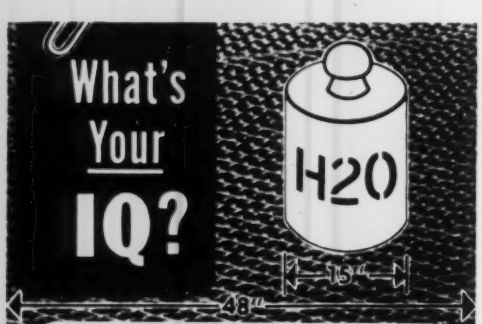

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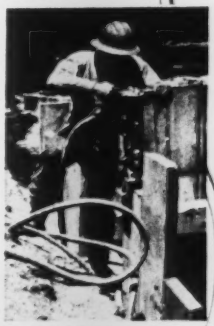

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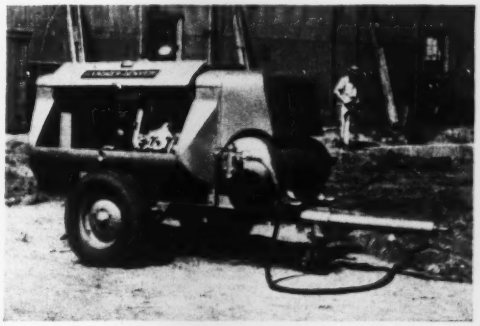

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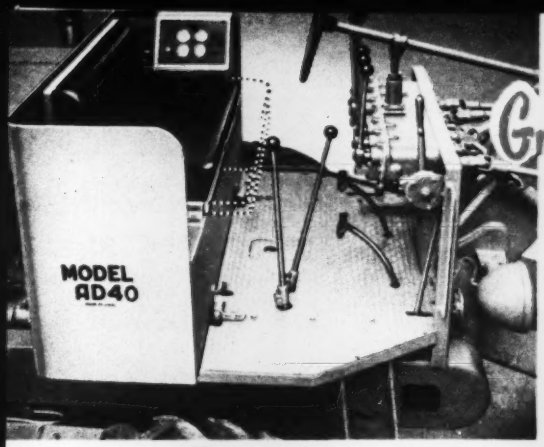

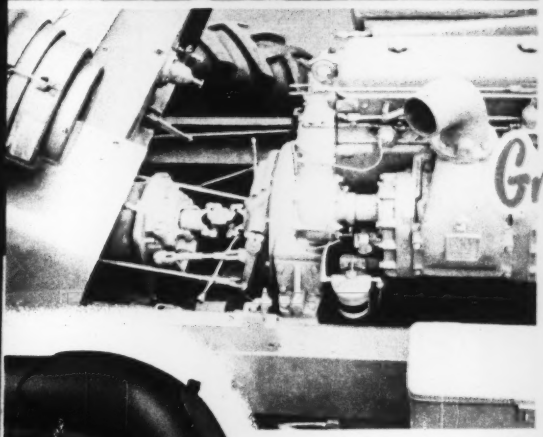

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Great New service simplicity

Here's maintenance and repair accessibility second to none. Combined fuel tank and seat unit tilts forward for easy access to clutch, transmission and drive shaft. Transmission can be removed without disturbing floor plates. Power take-off and hydraulic pump are mounted outside the dash.

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Add these outstanding operator and service advantages to the exclusive Allis-Chalmers features that include ROLL-AWAY* Moldboard—extra high clearances from front to rear—shock-absorbing tubular frame—dependable General Motors 2-Cycle diesel power . . . and you have the finest heavy-duty grader on the market. Get the full story on this new AD-40 from your Allis-Chalmers dealer now.

*ROLL-AWAY is an Allis-Chalmers Trade-mark.

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Traveling Mixing Plant

The Model 42 Roadmixer, traveling mixing plant, is now powered by an LHC CD18A rated at 425 hp at 1900 rpm. The previous power plant delivered 180 hp at 1800 rpm. The additional torque power of the engine produces an ultimate increase of approximately [illegible] more power. The rugged "Hell for Stout" construction reduces repairs and downtime. The tandem drive assures positive traction, even in low bearing soils. The roadmixer is pneumatic tire mounted for maneuverability over all types of surfaces. It is one of three complete traveling mixing plants built by

Model 42 Roadmixer

the company. The other two units are the Model 54, tractor-drawn and powered with capacity up to 350 tons per hour, and the Model 36, self-powered and self-propelled, with capacity up to 150 tons per hour. All three units are used for asphaltic and soil cement surfacing or resurfacing, and base course stabilization. **Wood Manufacturing Co., P. O. Box 620, 6900 Tujunga Ave., North Hollywood, Calif.**

Model 42 is self-propelled, the diesel engine supplies power for traveling and mixing. It picks aggregate cleanly off subgrade, thoroughly mixes it with binder in 42 in. pugmill while oil is hot, and produces a uniformly mixed windrow ready for spreading. It produces up to 200 tons per hour of quality mix. Windrows up to 6 ft in. It is one man operated and simplicity of design, fewer moving parts, and

Tamper

A faster, more efficient and economical method of building roads and airport runways has proven practical through use of the Vibro Tamper. The Vibro Tamper permits continuous one-course subbase construction, compacting up to 15 in. of loose aggregate to 10 in. in compacted lifts with a 95 percent proctor density. It eliminates the former two or even three course subbase construction previously required, involving costly duplication of labor. The self-propelled, crawler-mounted unit of all welded construction weighs approximately 9000 lbs. and is powered with an 85 hp motor. Power is furnished to the vibrating mechanism by means of V belts. The tamping mechanism consists of six vibrating shoes 24 in. wide by 18 in. long, weighing 435 lbs. each. Ground contact area of the shoes is approximately 18 sq ft. Eccentric gears and weights are used in each shoe to provide an impact force of 35 lb in. at a vibrating rate of 2880 to 2880 per min. with a compacting force of approximately 5800 psi. **Vibration Company, 16702 Waterloo Rd., Cleveland 10, Ohio.**

Hoisting Tower

A Waco material hoisting tower that assembles with standard Waco sectional scaffolding has been announced. The tower is available as either a double well or single well unit and can be erected in approximately 2½ hrs by three men. The unit features remote or pre-set platform control similar to the Waco portable elevator and the double well tower is designed for simultaneous loading and unloading at top or bottom of alternate wells. Other features include a "slow up" brake on the power mechanism to govern platform descending speed, and a safety slack brake which sets automatically in case of failure in the hoisting rig. Powered by interchangeable gasoline or electric power units with hoisting speeds of 100 and 110 ft per min., respectively, each tower has a capacity of 1000 lbs. Hoisting mechanism, consisting of cages, base with motor mount and cathead pulleys, is available as a package unit, or the complete tower may be purchased. For specifications, refer to form PS 28C. **Wilson-Albrecht Co., Inc., 3565 Wooddale Ave., St. Louis Park, Minn.**

Pencil Tracing Cloth

A pencil cloth with new qualities permitting the use of a liquid eradicator to remove large pencil areas cleanly, quickly and without disturbing the all important tooth of the original cloth is now being offered. Whitex Smooth is nice to work on and the surface produces sharp, jet-black detail from a 2H pencil. Good prints are assured by the extreme translucency providing a maximum contrast between pencil and the white background. Whitex Smooth and its companion eradicator is offered as a time saver. Write for free special demonstration kit for on the spot test proof. **The Frederick Post Company, 3650 N. Avondale Ave., Chicago 18, Ill.**

Masonry Saw

The model HD masonry saw, which is actually both a wet (dustless) and dry saw, can be converted to both a concrete and track saw. At any time the cutting head of the Model HD can be placed on the convertible (four wheeled) cart. The equipment is then ready for sawing concrete or

Model HD

asphalt patches or trenches in building floors, drives and walks. Through such a conversion it is possible to switch from sawing glazed tile, concrete block, and fire brick to sewer, water or gas lines and floor patches in a matter of minutes. Fractures from jack hammer operations are now confined within the sawed removal lines plus the elimination of spalling. By placing the convertible cart on tracks, a fourth use is accomplished. Stone slabs, transite sheets, pre-cast stone, large refractories, plywood and masonite can be placed under the elevated tracts and sawed with this convertible track saw. **Clipper Manufacturing Company, Suite 707, 2800 Warwick, Kansas City 8, Mo.**

Equipment, Materials & Methods (Continued)

Earth Drill

A BUCKET TYPE earth drill which bores 16 to 84 in. holes to a depth of 200 ft has been developed. The Calweld earth drill Model 150-A removes 21.5 cu ft of earth per pass to speed up such varied jobs as are required in heavy duty construction, mining and oil field work. It digs caisson pier holes with belled footings, pre-bores con-

Model 150-A

crete piles, drills water wells and cesspools, explores mineral deposits and tests soil conditions. Every operation of the Model 150-A is mechanically performed. A variety of interchangeable bucket-drills permit boring in almost every soil condition. All controls are centered in a single unit for raising the derrick, lowering the drill, lifting the bucket and powering the drill. Bucket is unloaded by a simple hand-tripping operation. Built on a skid frame, the Calweld earth drill can be mounted on any truck chassis two ton or larger. **California Welding & Blacksmith Shop, Inc., 7222 E. Slauson Ave., Los Angeles, Calif.**

Portable Washing Plant

A PORTABLE WASHING plant embodies all of the advantages of the previous Washi. More plant with the addition of a catwalk for complete access to all parts of the

80 Cu Yds Per Hr

machine for easier and more productive operations. The plant also utilizes mesh type screen guards to supplant the previous solid heavier type and additional strength has been given throughout for even more rugged wear. The capacity of the plant runs as high as 80 cu yds per hour and is completely portable for mobile operations. For further details ask for Bulletin No. 1650. **Lippmann Engineering Works, 4603 W. Mitchell St., Milwaukee 14, Wis.**

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ESL BIBLIOGRAPHIES

No. 3. Precision Investment Casting by the Lost Wax Process. 111 references. 1949. $2.50.

No. 4. Pallets Used in Modern Materials Handling. 114 references. 1949. $2.00.

No. 5. Machinery Foundations; Design, Construction, Vibration Elimination. 120 references. 1950. $2.00.

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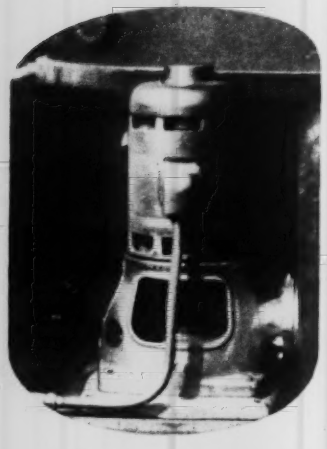

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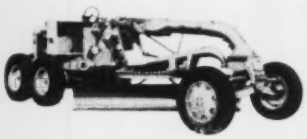
Equipment, Materials & Methods (Continued)

Motor Graders

TWO MOTOR GRADERS, models AD-40 and AD-30, were announced recently. The newly designed machines complete a line of five motor graders having a wide range of horsepower, weight and speed. They are embodied with design and construction features which offer new standards of performance, unmatched operating ease and complete service simplicity.



AD-40

The 4 cylinder, 2 cycle, diesel powered AD-40 weighs 23,000 lbs and develops 104 brake horsepower. The AD-30 is powered by a 3 cylinder 2 cycle diesel engine, weighs 22,700 lbs and develops 78 brake horsepower. Engineered for high production on any operation, the Model AD's include many features. The General Motors 2-cycle diesel engine can easily handle the heavy duty power requirements of any job. Tandem drive offers full traction under any ground conditions. High axle clearances, the "roll away" moldboard and accurate blade control all "combine" to move bigger loads faster, produce precision cuts or smooth finishes on a wide variety of applications, construction or maintenance. New standards of operating ease, incorporated into the AD motor graders, include easier shifting, complete visibility, feather touch hydraulically-operated steering and all around operator comfort. Accessibility to major assemblies, for service or repair, is an important feature. Accessories and special equipment are available for the motor graders to increase their adaptability to meet a wider variety of specialized applications and conditions. **Allis-Chalmers Manufacturing Company, Milwaukee, Wis.**

Equivalent Chart

A COMBINATION CONVERSION and decimal equivalent chart has been compiled. The chart converts inches to feet and metric equivalents all on one side. On the other side of the giant chart are the standard decimal equivalents. If is 17 by 22 in., protected with tin at both top and bottom, ready for hanging. Ask for Chart C. **The Frederick Post Company, 3650 N. Avondale Ave., Chicago 18, Ill.**

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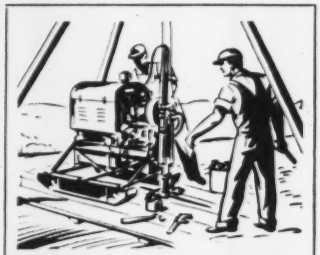

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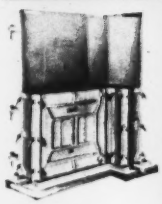

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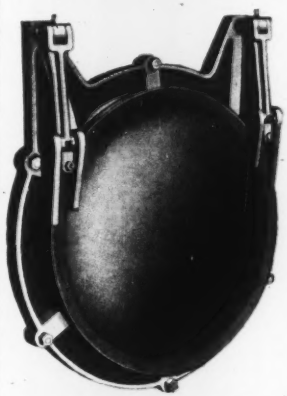

Fig. B-68. Type M (Circular) Gate

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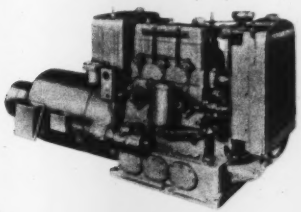
Equipment, Materials & Methods (Continued)

Hydraulic Lift

A RECENTLY DEVELOPED hydraulic lift, easily installed on truck mounted snow plows, claims instant-acting control from a push button on the dash. Because the lift is actuated by a hydraulic pump operated by the engine fan belt there is no battery drain. Further, the pump is equipped with a clutch which permits the pump to run only when power is needed. Such intermittent operation adds greatly to the life of the equipment. This clutch pump is also sold separately for remote control power on any truck with a fan belt and manufacturer of loaders, dump trucks and mowers are using it successfully. **National Lift Company, a Subsidiary of Gar Wood Industries, Inc., Waukesha, Wis.**

Diesel Engine

ADDITION OF A three cylinder diesel engine, conservatively rated at 30 to 45 hp within a speed range of 1200 to 1800 rpm, is announced. The engine, known as the 4FS3, has a 4¼ in. bore and 5½ in. stroke and is a four-cycle, vertical, mechanical injection diesel engine. Built as a complete, self contained, ready to operate unit, it is available as an electric generator set, pumping unit and with clutch or stub shaft power take-off for direct connection or belt drive. This dependable power unit



Diesel Generating Unit

is also available with heat exchanger cooling for marine auxiliary applications. The 4FS3 generator set is completely equipped and is delivered ready to connect to load. It is available in direct or alternating current models from 20-30 kw in all standard voltages, 50 or 60 cycle. This unit is built to economically generate light and power for stationary and portable power applications and marine auxiliary uses. With centrifugal pump attachment, the 4FS3-DE has a pumping capacity of 500 to 3000 gpm at 20 to 220 ft head. The 4FS3 diesel engines with direct or clutch power drives are readily adaptable for replacement engines in hoists, small shovels, etc., and can also be used as a power unit for driving well drilling machines, compressors, blowers, saw mills, oil field pumps, etc. **Nordberg Manufacturing Co., Milwaukee 1, Wis.**

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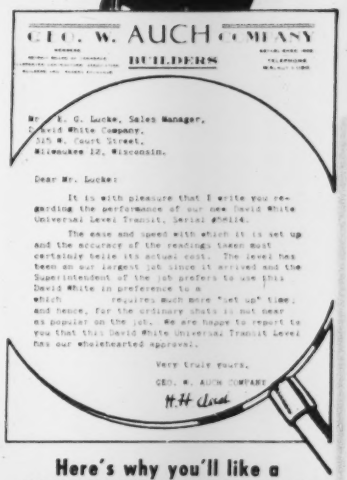

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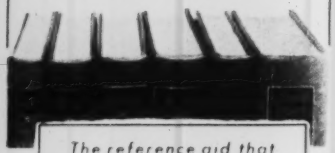

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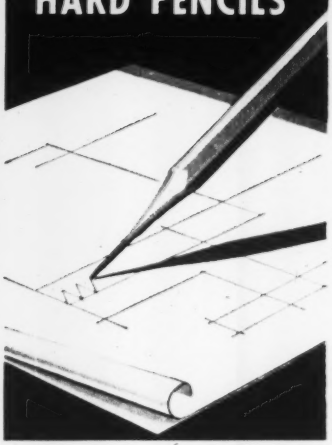

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Equipment, Materials & Methods (Continued)

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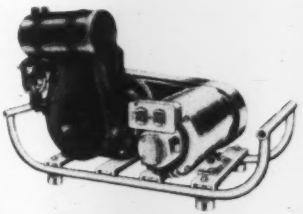
Generators

DEVELOPMENT OF A PORTABLE gas engine driven electric generator, Model 1800, in three general ratings 1000, 1250, and 1350 watts at 115 volts, 60 cycles, A.C. is announced. It is suitable for many power requirements of building contractors, emergency repair trucks, portable



Model 1800

power tools, floodlights, etc. The generator is rated conservatively and is ruggedly built. It is equipped with sealed ball bearings for long life. The belted construction cushions shock to the generator, reduces vibration and increases the generator life. The generator being mounted alongside the engine locates it out of the path of the hot air from the engine cooling system, thus promoting cooler generator operation. The unit is equipped with a universal mounting base which permits mounting any one of several popular makes of engines. **Wincharger Corporation, 2110 East 7th St., Sioux City 2, Iowa**

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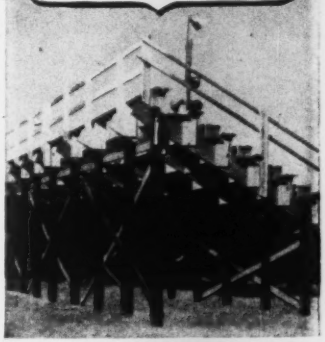

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Equipment, Materials & Methods (Continued)

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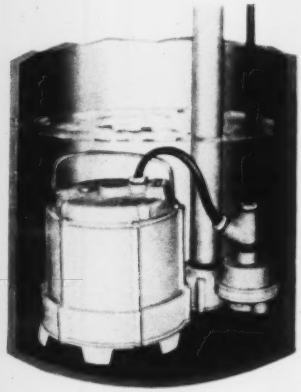

Completely Submersible

and draining tanks and vats. One of the most unusual advantages of the pump, results from the submersible feature. This is made possible by the patented Kenco automatic liquid level control switch which eliminates the need for a float. In sump usage, since the pump is submersible, the entire portable unit can be installed right in the sump in a few minutes rather than having motor on top of the sump supported by a permanent mounting. This pump is also ideal for utility purposes since it weighs only 50 lbs and can be moved and placed in operation very quickly. It is compact, measuring 9" in high and a maximum diameter of 13 in. Despite its small size, it has a capacity of 3300 gph. Although the unit is driven by a ½ hp motor, overloading to ¾ hp or greater will not cause the motor to fail as the motor frame size has been effectively increased by the oil filled, hermetically sealed construction. The cooling action of water surrounding the pump housing, effectively makes it possible to dissipate the motor heat. Model P-109MA is both manual and automatic, provided with a thru cord switch which permits manual starting at any depth of water. After starting manually, cord switch can be set to the automatic position and pump shuts off automatically. Kenco, Inc., 1125 North Ridge Road, Lorain, Ohio

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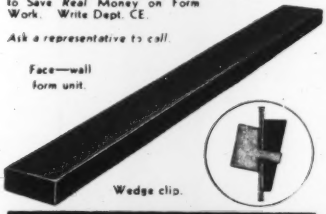

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Literature Available

MOBILE MIXING UNIT—Bulletin MP 51, offers complete details on the Moto-Patcher, a mobile mixing unit designed for easier, more economical road and street maintenance. Photographs, specifications and a moto-patcher flow diagram are included. **Hetherington & Berner, Inc., 701-745 Kentucky Ave., Indianapolis 7, Ind.**

HYDROHOE—A folder on the all hydraulic Hydrohoe is now available. The Hydrohoe has two separate digging actions: a conventional dragshovel action through a hydraulic ram located between boom and dipper handle, and a separate horizontal action by means of telescoping the boom. Many advantages are shown, and action photographs and other detailed information is included. **Bucyrus-Erie Company, Hydrocrane Division, South Milwaukee, Wis.**

MAINTENANCE AND CONSTRUCTION MANUAL—A 60-page manual has been distributed to all company supervisors and people concerned with safe and correct work practices in the maintenance and construction fields. Contents of the booklet contains a description of general standards, general rules for overhead work and excavations, safety rules for millwright and machine repair work, for electrical maintenance, and for plumbing and steam fitting, along with rules for outside contractors. Ask for manual, 25E7524, **Allis-Chalmers Manufacturing Company, Milwaukee, Wis.**

SOIL COMPACTION—Detailed information, including useful production data, for figuring work schedules and costs on soil compaction jobs is contained in a bulletin just published. It covers the use of the Barco portable gasoline "Rammer" for tamping fill or back fill in restricted areas. Of special interest to builders, contractors, supervisory engineers, and project managers is a discussion of the use of soil compaction as a means of attaining greater permanence, lower costs, and earlier completion dates on many construction projects. **Barco Manufacturing Co., Dept. R-12, 1801 Winnemac Ave., Chicago 40, Ill.**

ACCESSORIES FOR CONCRETE CONSTRUCTION—Catalog 500 has 56 pages on accessories for concrete construction. Form ties and clamps are grouped by class of construction, for ordinary foundations, for water tight walls, for engineering structures and for architectural concrete. There is also a section devoted to special products often required in concrete construction. Tables of concrete pressures in forms at summer and winter temperatures, recommended safe spacings of form ties, grouped by sizes of form lumber and safe tie capacities are given in an insert at the back of this catalog. **Superior Concrete Accessories, Inc., 4110 Wrightwood Ave., Chicago 39, Ill.**

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Literature Available (Continued)

SCAFFOLDING. An informative brochure describing short cuts and tricks of unusual scaffolding applications is now available. The usual scaffold jobs are shown, pointing out the advantages of Ezebilt's "No Bolts, No Loose Parts" features, but in addition, uses in tricky or complicated jobs are described and illustrated. "Write for Bulletin No. 130. **Universal Manufacturing Corporation, Zelienople, Pa.**

DRILLS. A brochure on Ka-Mo drills shows typical examples of unstable subgrades and the methods of correcting the conditions on the various railroads. Another page is devoted to pictures of the drills "Working on the Railroad." **Ka-Mo Tools, Inc., 1845 South 55th Ave., Cicero 50, Ill.**

SCRAPER. The Model TC S142 Terra Cobra self propelled scraper is described in an 8 page bulletin just released. Operational features and mechanical details are shown in a series of sectional, cutaway and assembly views. Request Bulletin No. TC-707. **Woolridge Manufacturing Company, Sunnyvale, Calif.**

HYDRAULIC JACKS. Complete information, including specifications and application data on hydraulic jacks, is offered in a bulletin just issued. The 8 page letter file size folder, known as Hydraulic 51-R, contains photographs, detail drawings and tabulated data on hydraulic equipment in capacities of from 10 to 100 tons. **Templeton, Kenly and Company, 1020 South Central Avenue, Chicago 44, Ill.**

CENTRIFUGAL PUMPS. An instruction booklet covering the installation, operation and repair of single stage, double suction centrifugal pumps has been released. The booklet recommends that a regular inspection be followed and includes a maintenance timetable which is based on continuous pump operation and which serves as a reliable pattern for all practical purposes. One page of the booklet is for use as a permanent record of the operator's pump and of its performance. The booklet also carries a quick reference guide which lists 40 possible causes of trouble in pump operation and their cures. Ask for 08 × 7013. **Allis-Chalmers Manufacturing Company, 1187 S. 70th St., Milwaukee, Wis.**

MAINTENANCE GUIDE. A 28 page, four color service booklet, "Small Engine Maintenance Guide," has been published. The booklet shows how good maintenance will add many hours of top performance to your engine. Maintenance facts apply to the six smaller sizes of "Cat" diesel engines, marine engines and electric sets. Full discussion is given to cooling, lubricating, air intake and exhaust and fuel supply systems. Also included are care of starting engines, marine gear and generators, along with cold weather hints and general facts. Ask for Form 30246. **Caterpillar Tractor Co., Peoria 8, Ill.**

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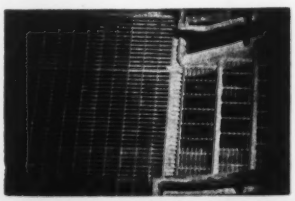

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PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 108.

Summarized in Earlier Issues

D-48. Discussion of Paper, **Hydrology of Mexico**, by Andres Garcia Quintero.

D-47. Discussion of Paper, **Origin and Significance of Openwork Gravel**, by Allen S. Cary.

D-43. Discussion of Paper, **Strength of I-Beams in Combined Bending and Torsion**, by Basil Soutochnikoff.

90. **Consumptive Use of Water by Forest and Range Vegetation**, by L. R. Rich.

91. **Consumptive Use of Water**, by Harry F. Blaney.

92. **Experimental Investigation of Fire Monitors and Nozzles**, by Hunter Rouse, J. W. Howe, and D. E. Metzler.

93. **Aircraft Design as Related to Airport Standards**, by Milton W. Arnold.

94. **Friendship International Airport**, by Benjamin Everett Beavin.

95. **Directional Requirements for Airport Runways**, by Ralph H. Burke and Harry Otis Wright, Jr.

96. **Surface Curves for Steady Nonuniform Flow**, by Robert B. Jansen.

D-36. Discussion of Paper, **Impossibility of Performance in Contracts for Engineering and Construction**, by Robert E. Borg.

D-39. Discussion of Paper, **Practical Design of Solid-Barrel Reinforced-Concrete Skew Structures**, by Bernard L. Weiner.

D-42. Discussion of Paper, **Wind-Load Standards in Europe**, by John W. F. Van Erp.

D-43. Discussion of Paper, **Settlement Correction at La Guardia Field**, by John M. Kyle.

D-44. Discussion of Paper, **The Problem of Wave Action on Earth Slopes**, by Martin A. Mason.

97. **Consumptive Use in the Rio Grande Basin**, by Robert L. Lowry.

98. **Consumptive Use of Water on Irrigated Land**, by Wayne D. Criddle.

99. **Consumptive Use in Municipal and Industrial Areas**, by George B. Gleason.

Third Notice

100. **Forced Vibrations of Continuous Beams**, by Edward Saibel and Elio D'Appolonia.

101. **Application of Highway Capacity Research**, by J. P. Buckley.

102. **Utilization of Ground Water in California**, by T. Russel Simpson.

103. **Pile Foundations for Large Towers on Permafrost**, by L. A. Nees.

104. **Redesign of Major Airport Terminals**, by Herbert H. Howell.

105. **Principles of Highway Capacity Research**, by O. K. Normann.

D-45. Discussion of Paper, **Design of Prestressed Tanks**, by J. M. Crom.

D-47. Discussion of Paper, **Operation and Maintenance of Irrigation Systems**, by Raymond A. Hill.

107. **Characteristics of the Solitary Wave**, by James W. Daily and Samuel C. Stephan, Jr.

108. **Control of Embankment Material by Laboratory Testing**, by F. C. Walker and W. G. Holtz.

109. **Final Foundation Treatment at Hoover Dam**, by A. Warren Simonds.

110. **Review of Flood Frequency Methods**, final report of the Subcommittee of the ASCE Joint Division Committee on Floods.

111. **Research in Water Spreading**, by Dean C. Muckel.

D-49. Discussion of Paper, **Large Hyperbolic Functions Computed by Fission**, by E. T. Llewellyn.

D-54. Discussion of Paper, **Truss Deflections by the Coordinate Method**, by Kuang Han Chu. In Proceedings-Separate No. 54.

D-61. Discussion of Paper, **Structural Damping in Suspension Bridges**, by the Late Friedrich Bleich and L. W. Teller.

Second Notice

112. **Diversions from Alluvial Streams**, by C. P. Lindner. The hydraulic effects of diversions from alluvial streams and the withdrawal of bed load are rather comprehensively discussed. Less known hydraulic influences are described. Reasons for the withdrawal of bed load in amounts differing from the quantities of water diverted are given. The effects of diversion on the channels involved and the long time trends that may be expected after diversion are explained. Suggestions are made for the siting of a diversion in order that desired results may best be accomplished. (Available February 1.)

INSTRUCTIONS

1. Papers are to be ordered by serial number. Please keep record of Separates you have ordered to avoid unwanted duplication.

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Standing orders for all Separate papers, including their Discussions, in any calendar year, may be entered at the following annual rates: Members of ASCE, $3.00 (beginning January 1, 1952, $5.00); members of Student Chapters, $5.00; non-members, $10.00, plus foreign postage charge of $.75; libraries, $5.00.

TRANSACTIONS. All PROCEEDINGS papers, with discussions, will be included in TRANSACTIONS. Annual volumes of TRANSACTIONS will continue to be available at the currently established annual subscription rates.

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113. **Wave Forces on Breakwaters**, by Robert Y. Hudson. The two principal types of breakwaters are vertical wall structures and those with sloping faces constructed of rubble. This paper reviews (a) the existing wave pressure theories for determining the magnitude and distribution of wave forces on vertical walls, (b) the particular wave theories upon which most of the wave pressure theories are based, and (c) theories for determining the weight of armor and required slopes of rubble mound breakwaters. The different theories are compared and the best are selected for use. Also, the results of the better theories are compared with experimental data and a suggested outline of future investigations considered necessary to insure safe and economical breakwater design is presented. (Available February 1.)

114. **Utilization of Underground Storage Reservoirs**, by Harvey O. Banks. To meet the ever increasing demands for additional water supplies at reasonable cost, planned development and utilization of the immense potential storage capacity available in ground water basins will be necessary since few surface reservoir sites of large capacity, high yield and low cost remain undeveloped. The paper discusses ground water hydrology in relation to such development and utilization and describes some of the problems connected therewith. A proposed project for Ventura County, California, utilizing underground reservoirs for cyclic storage with relatively small surface reservoirs operated as regulatory storage to increase recharge to the ground water basins is described. As compared to utilization of surface storage alone, large savings are indicated. (Available February 1.)*

D-81. Discussion of Paper **Laterally Loaded Plane Structures and Structures Curved in Space**, by Frank Baron and James P. Michales (January 1951). Procedures for analyzing structures curved in space and loaded in space and loaded in any direction. Discussers: Ekin Müllershoff, Maurice Barron, and Frank Baron and James P. Michales. (Available February 1.)

D-87. Discussion of Paper **Design of Irrigation Systems**, by W. H. Nalder (February 1951). The principal features of three multiple-purpose projects emphasizing the planning and design considerations in the development of irrigation features. Discussers: Ahmed Shukry and W. H. Nalder. (Available February 1.)

D-60. Discussion of Paper **Surveying and Mapping Requirements for Modern City Planning**, by Charles A. Blessing (February 1951). Reasonable standardization needs in the mapping and surveying procedures of planning commissions in all cities large and small. Discussers: Harold M. Lewis, Leon I. Ehlen, and Charles A. Blessing. (Available February 1.)

D-62. Discussion of Paper **The New Towns Program in Great Britain**, by T. C. Coote (March 1951). Description of the planning of fourteen new towns in Great Britain erected by development corporations employing their own staffs or by outside consultants. Discussers: W. Strickler, and T. C. Coote. (Available February 1.)

First Notice

115. **Lake Michigan Erosion Studies**, by John R. Hardin and William H. Booth, Jr. Erosion problems along the Illinois shore of Lake Michigan are analyzed in this paper. The reach described has been divided into four sections and the solution of the problems peculiar to each section has been recommended. Protective structures such as groins, submerged breakwaters, piers, and artificial fills are described and their effectiveness in correcting and preventing future shore erosion are evaluated. The proposed solutions discussed call for gradual building of new beaches to provide protection of the shore line as well as development of recreational facilities for the neighboring population. (Available March 1.)

116. **Graphical Solution of Hydraulic Problems**, by Kenneth E. Sorensen. A general method of graphical integration of differential equations is described and the method is applied to specific hydraulic problems. Examples are given for solution of problems of reservoir flood routing, backwater curves in channels, and surge tank water-level variations. The method is claimed to be an improvement over those now in use in that trial and error computations are eliminated, less time is required for solutions, and checking is greatly facilitated. (Available March 1.)

117. **Development of Stresses in Shasta Dam**, by Jerome M. Raphael. During the construction of Shasta Dam, strain meters and other instruments are imbedded in the concrete. The results of long-term observations of the stresses found at the base of the spillway section of the dam is presented in this paper. An attempt is made to draw conclusions regarding the behavior of gravity dams in general from observations of the structural behavior of Shasta in the period since its construction in 1940. (Available March 1.)

118. **Flocculation Phenomena in Turbid Water Clarification**, by Harvey E. Ludwig, W. E. Langelier, and Russel G. Ludwig. Synthetic turbid waters mixed for these experiments were made by suspending clay in water in the presence of varying amounts and types of alkalinity. The clay particles had varying ion exchange capacities and varying particle coagulants. Various interfering substances were added during the experiments, including sequestering and surface active agents. A comprehensive theory of flocculations is developed, which represents the attainment of a complex equilibrium in which many variables are involved, including turbidity, particle size distribution, exchange capacity, pH, and alkalinity. (Available April 1.)

D-59. Discussion of Paper **Limit Design of Beams and Frames**, by H. J. Greenberg and W. Prager. Statically indeterminate beams or frames, were analyzed by limit design in this paper, published in February, 1951. Discussers are: E. E. Grinter, F. K. Silverman, J. Benjamin, E. P. Popov, A. Hrennikoff, P. S. Symonds, H. Lachs, V. Francois, and H. J. Greenberg and W. Prager. (Available April 1.)

D-56. Discussion of paper, **Turbulent Transfer Mechanism and Suspended Sediment in Closed Channels**, by Hassan M. Ismail. The effect of sand in suspension on the universal constant of turbulent exchange, distribution of momentum transfer coefficient and the coefficient of friction, are described in this paper published in February, 1951. Discussers are: Emmett M. Laursen, M. R. Carstens, and Hassan M. Ismail. (Available March 1.)

D-70. Discussion of **Regime Theory for Self-Formed Sediment-Bearing Channels**, by T. Blench. Rational formulas are developed in the paper (May, 1951), for rivers in India, under conditions of sediment-laden water, excavated canal boundaries or erodible alluvium, and very flat country. Discussers are: Emmett M. Laursen, Gerard H. Matthes, and T. Blench. (Available March 1.)

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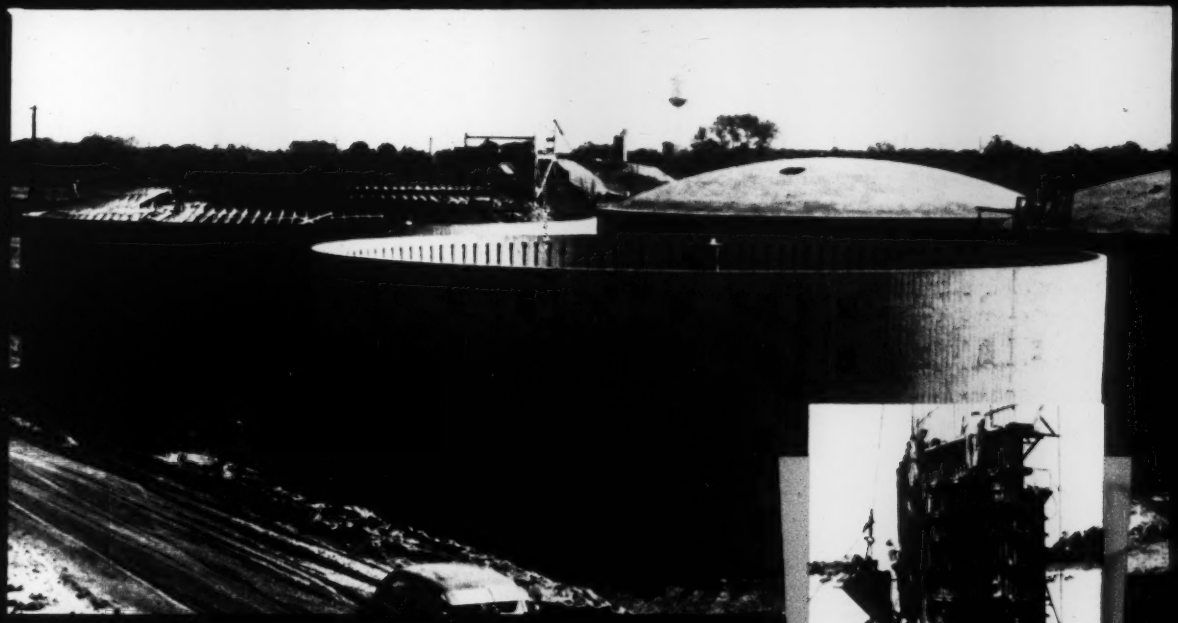

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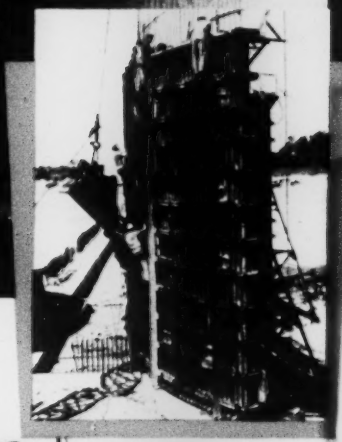

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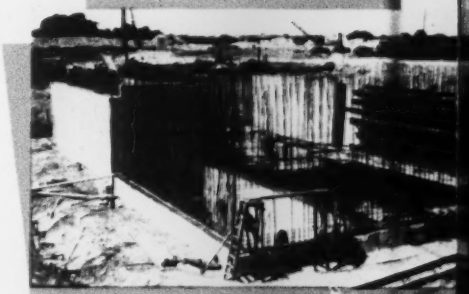

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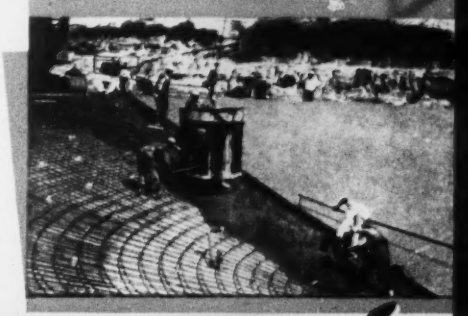

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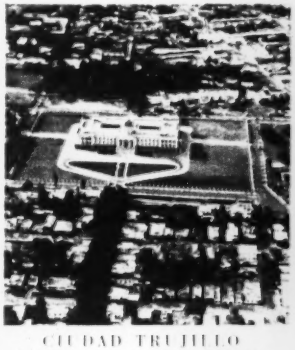

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